THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. X.—No. 224.

ELECTRICITY AND THE MEDICAL PROFESSION.

IN the inaugural address of Lieut.-Col. Webber to the Society of Telegraph Engineers and of Electricians, he says: "The members of the medical profession should be induced to join the Society, that their knowledge in the curative applications and principles of electricity might be perhaps increased, for the day was approaching when the study of electricity in its physiological functions would be of paramount importance to medical men. The Electrical Congress at Paris had initiated the practice, and the publication of its reports might further the idea suggested and result in the production of papers on electro-physiology." We quite agree with the gallant president of the Society, and there are already signs that his well considered remarks will shortly bear fruit. Forty years or more ago, we believe, the science of electro-physiology was much more thought of and carefully studied than it is in our days. Indeed at present, and for some years, the subject has been sneered at and ignored by the majority of modern electricians and of the medical profession. This may be accounted for by the extraordinary amount of swindling and charlatanism, regarding the curative properties of electricity or magnetism, to which we have been subjected of late years at the hands of quacks utterly ignorant of the elements of electrical science. However, a reaction is taking place, and electro-physiology and a good knowledge of electrical science generally will probably be one of the chief subjects for the future education of medical students. It will not be out of place to mention here that the matter we are now dealing with was treated on, for the first time we believe, before an assembly of electricians, by two well-known medical practitioners at the last meeting of the Society of Telegraph Engineers. The physiological effects developed by electricity when in a state of tension have long been well known. The effects of the shock of course vary, and may be made sufficiently strong to destroy life, especially if the stroke be conducted through the skull. Frictional electricity was frequently applied for medicinal purposes before galvanic batteries were introduced.

The conduction of successive and momentary currents through parts of the animal organisation produces a contraction of the nerves and muscles by which the activity of the vascular system is increased, the motion of the fluids accelerated, and the animal heat raised. The physiological effects of the galvanic current on our nerves and muscles are the same as those produced by frictional electricity, modified however by several characteristics, for the action of the current from a battery is continuous, and there is also present the chemical influence which excites the organs of taste and sight in a remarkable degree. With a battery sufficiently strong, violent shudderings in the fingers, arms, and even in the chest, are experienced, besides occasioning in any sore places a sensation as if the skin were being burnt or pricked. The shock from a galvanic battery may be distinguished from that of frictional electricity, for the latter is felt far less deeply, affecting only the outer part of our organs, and being immediately exhausted; the shock from a battery, on the contrary, penetrates further into the system, propagating itself along the entire course of the nerves. The electric current has, in many instances, been successfully applied to the restoration of persons in whom animation was suspended. In connection with the study of electricity as applied to medical purposes should be that of animal electricity, or the existence of electrical currents in living muscle. This was, as it is well known, first discovered by Galvani, in his celebrated experiments with the nerves and muscles of frogs. Since his time much good work has been done in this direction by Nobili, Matteucci, and others; and during late years Du Bois Reymond has entered deeply into the investigations of the existence of currents in living muscles and nerves. Such a study would be of the greatest possible advantage to the medical student, and would vastly increase his anatomical knowledge of the human frame, and the result would doubtless be the discovery of new and better methods of dealing with certain of the maladies to which the flesh is heir.

It does not seem, however, that the curative application of electricity has ever been reduced to a scientific basis, and although we are aware that a considerable number of medical coils and batteries are continually being manufactured and sold, the application of such remedies to human ailments, with but few exceptions, has not got beyond this. A person is ill, and amongst other remedies for his complaint a medical coil or battery is used; the patient gets well, whether from the use of the electric current or from ordinary prescriptions no one knows. It is, however, put down as a wonderful cure by means of the electric current, although this may have been applied by chance or guesswork to any part of the frame, and without any knowledge of its strength or what takes place in the human organism when so applied. In fact, we fear that the application of electricity in medicine up to the present (some hospitals perhaps excepted) has been in most cases performed, not only with an utter want of knowledge and disregard of the properties of the electric currents, but also without the least idea of what the results were likely to be.

That electricity has been used with great advantage in innumerable cases of illness cannot be denied, and that it is destined to take an important place in the medical practice of the future is equally sure; but there are two classes of practitioners by whom it may be dangerously employed. There is the medical man who applies electricity without knowing anything whatever about it; and there is also the more dangerous quack who advertises electricity as the universal panacea for every ailment, and applies it indiscriminately to all patients without any knowledge of medicine, or the delicate mechanism of the body. Taking the following as an instance, it may not generally be known that Dr. Duchenne has found that in electrifying the muscles of the face induction currents are to be preferred, as such currents only act feebly on the retina, while the currents from a battery act energetically on this organ, and have often affected it dangerously. Although there is yet such an uncertainty as to the real effects of electricity, the cases

in which it should be applied, and the best mode of applying it, there is no doubt that such a vague state of knowledge on the subject of electro-physiology will soon be made clear; and this will be most easily and satisfactorily accomplished if medical men who are experimenting in this science will bring forward their results before the meetings of the Telegraph Engineers' Society, where the matter could be discussed by those whose sole desire would be to establish for it a scientific basis, and not to advocate this or that system of magnetic or galvanic bands or appliances.

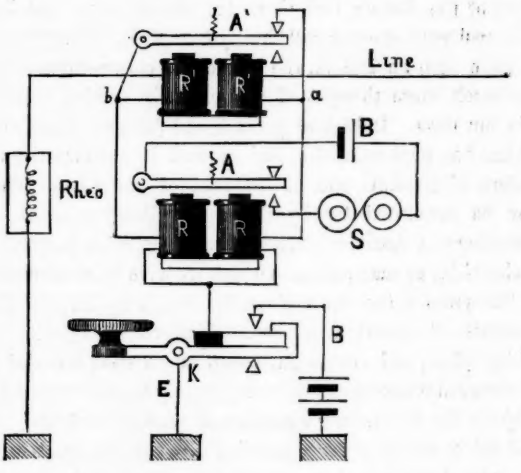
Electricity has often proved an excellent servant to those whose object has been the destruction of human life, and indeed its application to warfare forms a most interesting study, and much ingenuity has been displayed in suiting it to this purpose. Surely as much interest will be taken in adapting the subtle influence of this mysterious force to the preservation or lengthening of our lives, and if the paper which was read before the Society of Telegraph Engineers and of Electricians by Drs. Stone and Kilner was of sufficient importance in dealing scientifically with the application of electricity to medicine, we feel quite sure that these earnest workers will be encouraged to make every effort to establish electro-physiology on its proper footing, and thus to add another branch to those now in existence, where electricity can be usefully or beneficially employed. We need hardly say how important it is that a thorough knowledge of electrical currents should be obtained before they are applied in medicine, and the prudence which is necessary in their use. In a portion of Matteucci's lectures on the physical phenomena of living bodies occurs the following passage:—"In commencing, a feeble current must always be used. This precaution now seems to me the more important as I did not think it so before seeing a paralytic person seized with almost tetanic convulsions under the influence of a current formed of a single element. Take care not to continue the application too long, especially if the current is energetic. Rather apply a frequently interrupted current than a continuous one, especially if it be strong; but after twenty or thirty shocks at most let the patient take a few moments' rest." It appears, however, that at the present time continuous currents are almost solely used, whether beneficially or not we must leave it for the future to decide. In concluding our remarks on this most interesting but neglected study of electricity, we wish to express our belief that papers on such a subject as this cannot fail to be of service to both the medical profession and the Society of Telegraph Engineers. To the members of the latter it will open out a field almost unknown for original and useful research, and medical men cannot fail to gain much valuable information concerning the properties of the currents they use by subjecting their theoretical ideas and experimental results to discussion and criticism at the hands of professional electricians.

ELECTRIC LIGHTING AND ART.—Hans Makart's colossal painting (32 ft. by 15 ft.) of "Diana's Hunting Party," is now on view at the Central Exchange Art Gallery, Newcastle-on-Tyne, and is lighted nightly by twenty-four Swan's incandescent lamps. The lamps are arranged in a row within a foot of the floor, being about a foot apart. The lighting is very effective, each figure and shade of colour being exhibited with great distinctness.

NEW STATIC CHARGE COMPENSATION FOR DUPLEX CIRCUITS.

A VERY ingenious device for overcoming troubles due to static charge and discharge on duplex lines has been invented and patented in the United States by Mr. C. L. Buckingham, entirely novel in its conception, and depending for its operation upon the idea of dividing the charge and discharge through the home instruments in such a manner that no false signals occur. In the diagram, K represents a well-known continuity preserving key, B, the home battery, and R, the home relay differentially wound as usual, the main line branch being carried around the second electro-magnet, R^1, in one direction, and the artificial branch around the same electro-magnet in a reverse direction to earth through the resistance "Rheo," equal to the main line resistance. A bridge of low resistance connects the main and artificial lines at *a* and *b* through the armature, A^1, of the second differential electro-magnet, R^1. S is the home sounder, and B^1 its local battery, closed for distant signals through the armature, A.

On connecting B to line the static effect is the same through both branches of R by reason of the bridge affording an easy path to the main line. The static effect upon



R^1, however, is unequal, as in an ordinary differential instrument, but its armature is adjusted to such a nicety that it will not break the circuit for a quick decisive static charge, hence A remains unaffected.

Similarly the static discharge is unable to produce any effect upon A^1, and hence the flow back to earth through R^1 splits at *b*, and A remains unaffected, and no false signal occurs. When, however, a signal is sent from the distant station the current enters through R^1, and inasmuch as it acts only through one half of this relay, the bridge is broken, and all of the current finds exit through one half of R to earth, and a signal is received. If keys at both stations are operated the same result follows, and both signals are received. If the electro-magnet, R^1, were made somewhat more sluggish than R, better results might be expected.

Mr. Buckingham has opened up by this invention a delicate balance for duplexing, and a method entirely feasible as well for duplex telephony; inasmuch as the well-known appliances for overcoming static troubles in telegraphy are entirely too crude and unreliable for telephony, owing to the extreme delicacy of the instruments. The substitution of a microphone or carbon button in the bridge for the armature, A^1, or rather in connection with the said armature, would make an operative duplex telephone, the ordinary telephone transmitter being substituted for the transmitter K, with battery at E.

REVIEW.

Journal of the Society of Telegraph Engineers and of Electricians. Vol. X. No. 39.

AMONGST recent publications relating to electricity, perhaps the least striking of all is the last number of the journal of the above Society, written by Englishmen, supervised by an editing committee, and edited (at least as far as the quality, rather than the quantity of the matter, is concerned) by Professor W. E. Ayrton.

We can well understand and sympathise with an editing committee who find themselves face to face with a loosely-written paper, supposing of course that their zeal in the interests of the Society which appoints them occasionally exposes them personally to such a position. It is not every member of a Society who will write a paper even as a peg to hang a discussion on, and those who do write one must not be lightly offended. Still, without the risk of being offensive, surely much might be done in a quiet way to soften to some extent any literary eccentricity which may come under their notice. Indeed, a very slight alteration with a light hand might from time to time satisfactorily effect an improvement in many very well-meaning communications. As an instance of what we mean—and we instance it in order that our meaning may not be liable to misconstruction—there is, we believe, a rule that in the "Proceedings of the Institution of Civil Engineers" papers shall be written entirely in the third person. "I" and "we" are quietly discountenanced by the able editor and secretary; and the proof of a paper when it reaches publication may be a trifle less egotistical in its diction, but is sometimes more readable in its English, than when it leaves the hand of its author.

A glance at Mr. Lunds' paper on "Synchronising by Electric Time Signals" will suffice to show how advantageous such a rule and such an editorial revision might be to the journal we are discussing. Mr. Lunds commences his paper by assuring us—a needless assurance, by the way—that it "evolves no new discovery, . . . and advances in no new direction the existing knowledge of electrical laws;" and that it only professes to be "an attempt to demonstrate the results to be obtained from a practical use of a very limited acquaintance with the science of electricity." A perusal of Mr. Lunds' paper would have rendered this information superfluous, if he had not been justified in assuming that many readers would, perhaps, not get so far as to discover the fact for themselves. Of Mr. Lunds' method of setting clocks by periodically putting back or pushing on the minute hand, we can only speak in terms of the highest praise. The thing is simplicity itself and most effectual, and we wish Mr. Lunds an increased business, and all the support which his work decidedly merits. But that which we take exception to is the expenditure of a third part of the Society's journal, including several awkward sheets of drawings, upon details which might profitably have been condensed into a fourth part of the space they monopolise, and the greater part of which is utterly useless, if not uninteresting, to the majority of the members of the Society of Telegraph Engineers and of Electricians, to say nothing of the something more than suspicion of a trade advertisement which suggests itself during a perusal of the paper. If at the meeting of the Society the members present were inflicted with the details of the article as it stands, surely the readers of the journal might have been spared the paper served *au naturel*, with its liberal allowance of italics and personal pronouns. The italics are consistent enough throughout in their apparently accidental employment; but the personal pronouns are not so. Mr. Lunds begins with "I," but quickly falls into "we," which he maintains for a page or two; and then having, as he calls it, "cleared the way" by a complacently superficial glance at a few other systems, resumes, with apparent self-approval, "I." We find no fault with Mr. Lunds, who does not profess to be a polished author. He comes before the Society with a very simple clock-setting arrangement, which has been for a good many years before the public, and is therefore familiar, and he explains the system in his own way and in his own language. We think he was certainly entitled on the part of the editing committee to that well-meant advice and assistance which they are supposed, in accordance with their duties, to be capable of affording, and for which they are supposed to be appointed. The present system, if system it can be called, of editing such a paper, when regarded in comparison with the attention devoted by the responsible editors of other scientific societies, is, to say the least of it, a careless one.

The next paper in the journal is a "Report upon the International Exhibition of Electricity in Paris, 1881," written by Sir C. Bright and Professor Hughes. This so-called report commences by giving as its *raison d'être* that "the important part taken by this Society in regard to the British section of the International Exhibition of Electricity at Paris, appears to call for some record in the Journal of the Society." In our opinion the financial sacrifice on the part of the Society and its members not only *appears* to call for a record, but *entitles* them to something immeasurably better than that which appears to be forthcoming. Exhibitions of electrical apparatus are no novelty, and precedents enough exist to show what such a report should aim at. In 1851 the electrical exhibit formed a prominent feature of the Exhibition in Hyde Park, and in the reports of 1854 in Paris, the advances made in three years were also marked and recorded. In 1862 Professor Fleeming Jenkin made intelligent comparisons between the electrical exhibit of that year and those of preceding years, and drew valuable deductions from the evident tendencies. The year 1867, the Paris Exhibition, formed another landmark in electrical progress, and the English reports traced, reviewed, and carefully considered the advance made in the interval. The Loan Collection of Electrical Apparatus at South Kensington in 1876 was the next step; then followed the 1878 Exhibition in Paris; and lastly that of 1881—the first which has been devoted exclusively to electricity and magnetism, and therefore affording a valuable means of forming a basis of comparative progress, and of gaining a useful lesson. It was understood that the English Government would not contribute towards the affair, and we have therefore no hope of seeing any proper Report appear by their instruction.

The Society of Telegraph Engineers and of Electricians in coming forward to represent and encourage English exhibitors, and which they did right well, would have acted more consistently had they supplemented their work by the issue of a well and carefully considered report, worthy alike of the Society and of the occasion. Instead of this we are treated to a sort of hop-skip-and-jump run through the Exhibition, which might have served as a useful guide to the general visitor, but which in the pages of the Journal of the Society is decidedly out of place.

In fairness we cannot speak too highly of some of the short abstracts of foreign papers which occupy a few pages: they are well and carefully written, and are indeed the redeeming point of at least this number of the Journal.

A copious index to Vol. x. is also given, but it might have been improved by avoiding the needless repetition of the same initial word, whether of names or otherwise, instead of following down in an inner margin as is usual, and much less inconvenient. Without alluding to the names, we may say that "Discussion on" occurs no less than twelve times in full, and so on. *Apropos* of this index, would it not have been possible to commence the index with a fresh sheet, so that its removal would not leave a loose leaf in the body of the number, which might easily get astray before the next volume is bound?

STORAGE OF POWER.

By Professor W. E. AYRTON, F.R.S.

Lecture delivered at the London Institution on Thursday, March 2nd.

THE subject of this lecture has been called by the world at large, and even by the well-informed *Punch*, "Storage of *Force*." Why, then, have I ventured to differ from so public an authority in my title? The fact is that it is as impossible to store force as to store time. There is as much difference between force and power as between a mile and the speed of a railway train. Power involves two ideas combined; Force only one. For instance, I have on this table a piece

of wood; it presses the table down with a certain amount of force, and the table presses its weight up with an equal and opposite force. But that is not storage of force. The mere resting of this weight on the table stores nothing, and it is beyond the power of the most accomplished engineer to move a machine simply by a direct weight on the table. The very name, dead weight, shows how useless such an arrangement is for the production of work. The weight on the safety valve of a steam engine may control the pressure at which it is working by liberating the excess of steam, but such a weight can, of course, never work an engine. What, then, is the other component idea, in addition to force, that must be present in order to produce work? The answer is, motion. Work is force exercised through space. If I raise this wood, I do a certain amount of work. The operation of raising it is doing work, and the greater the weight raised, and the greater the distance from which it is raised, the greater is the amount of work done. The raised weight is in a different condition from what it was when on the table. When I raise it, it can fall, and in falling do useful work. The raised-weight store of power we employ to drive our clocks, to help us to open our windows, to raise our chandeliers, and also for many other useful purposes. The continuous evaporation of the waters from seas and rivers by the heat of the sun also supplies us with a large raised weight store of power, because the water can fall upon the hill sides, and in doing so turn water-wheels and turbines. The vast fields of coal underground also give us an enormous store of power. The initial work in these cases is analogous to the winding up of a clock, being performed by the leaves of plants and trees, which, under the action of the sunshine, form wood, and this, after lying long ages, turns into coal. But there are other substances beside coal and oxygen which we find separated in nature, and which therefore form stores of power. For example, blocks of pure copper, which are found near Lake Superior, are a very valuable store of power. They are too valuable to be used as a fuel, and in addition they are only poor heat-givers, but still they have in them, of course, a very large amount of power. Zinc is rarely found pure and uncombined in nature, but when separated from the oxygen which it usually contains, the tendency of the zinc and the oxygen to come together forms a very valuable store of power, in fact, almost the sole store of power made use of by telegraph companies in galvanic batteries, &c., to work their telegraph instruments. In all the preceding cases, the store of power is produced by the separation of two bodies wanting to come together; and you may remember that about this time last year, in my lecture upon the production of electricity, I showed that an electrified body could do work if separated from another body charged with an opposite kind of electricity. We may also have a store of power through two bodies being too near together, and wanting to part from one another. For example, in a coiled spring, in a reservoir of compressed gas or air, or in two similar electrified or magnetised bodies. I have got here several examples of stored power, which we shall now utilise one by one.

In a series of experiments the lecturer showed how a falling weight may be utilised to do such work as turning a grindstone, and how a head of water could be made useful in turning a water-wheel and so raising the weight; and also how, in a gas-engine, the potential energy of the gas could be made to work a saw or turn a lathe. Finally, an illustration was given of the power of electric energy produced by the tendency of zinc and oxygen in a battery to come together. The lecturer continued: We have also another store of electrical power of a different kind, of which I shall have to say a good deal later on. The water in the cistern above the lecture room, which was utilised for turning a wheel, was pumped up for domestic purposes, and not primarily as a source of power. Of course natural stores of water power on the hill tops can be utilised for similar purposes, but artificial sources can be employed by such means as Sir W. Armstrong's water accumulator. If we pump water into a cylinder of a hydraulic ram, we can raise enormous weights, as, for example, in steel works, for moving about masses of steel, or in docks, to open gates. But it would be very inconvenient to have to pump the water every time we wanted to move the piece of steel. To avoid this, water is pumped periodically into the cylinder, which contains a piston very heavily weighted; and in the gradual falling of the weight, the piston forces out the water, and supplies the necessary amount of work in any part of the factory as required. Such an hydraulic ram is only a form of the raised-water store of power, and of the same nature is the weight wound up in the clock. I want to consider how far it is possible to use these various stores of power for the purposes of driving, say a tram-car, on an ordinary London road. An ordinary tram-car weighs about two and a-half tons, or when full, about four and a-half tons. To drive such a car as this requires an expenditure of about one and a-half horse power, to produce which for one hour means about 2,800,000 foot-pounds of work. Supposing, then, this amount of work were to be produced by a weight raised up on the car and falling during the journey, by which to move it, what would be the weight required? If the distance to which it was raised were 10 feet, it would require a weight of about 100 tons. Hence Armstrong's accumulator, so valuable in the manufactory, would be absolutely useless for such a purpose, because the weight raised at the commencement of the journey, and the gradual falling of which was to drive the car, would be the utterly unmanageable one of 100 tons. Springs coiled up at the commencement of the journey might be tried, the uncoiling of which would drive the car, but this would be hopelessly cumbersome and impracticable. Steam-engines are occasionally employed, as you know, and from the point of view of economy are superior to horse power; but the disadvantage of the noise, and the smoke, and the terror of the horses in other vehicles, is against them. The detached steam-engine, too, weighs about as much as a full car, so that the horse power employed in pulling the two would be simply moved in moving the engine and boiler. The detached engine, too, loses heat from the boiler very rapidly, and there is also a considerable waste of oil and tallow, &c.; and when cleaning it causes an expenditure which is not so much felt with stationary engines. Consequently the fact that steam-engines are more economical than horse power only shows how hopelessly uneconomical this latter method of traction, the remnant of the old coaching days, really is. The gas-engine worked with ordinary coal gas, probably compressed in cylinders on the car, might be employed, and it would be a great saving in weight in the absence of the boiler; but although it is possible to use this, it is not at all economical, though instead of ordinary illuminating gas, a cheap heat-giving gas, like that of Dowson, could be substituted. Still the weight of the gas-engine is so very much greater than the steam-engine per horse power employed, that it is almost impossible to use gas-engines for any such mode of propulsion. Compressed air-engines have been employed comparatively recently with a certain amount of success by Colonel Beaumont on the North London Tramway; but they have some disadvantages which attach themselves to detached steam-engines, that is to say, the weight of the engine is so large compared with the weight of the car, that although Colonel Beaumont succeeded in putting in one cubic foot of air compressed to 1,000 pounds pressure to the square inch, he could only drive a car three tons in weight half a mile, and the compressed air engines weigh about seven tons, whereas the car only weighs about five. That is to say, 7-12ths of the whole power is employed in merely pulling the compressed air engine. To obtain mechanical motion we require a store of power, and some method of converting the energy stored into mechanical work. Now, experiments show us that the weight of an electro-motor is very much less than the weight of a steam-engine and boiler for the same horse power developed. For example, take this little machine which I hold in my hand. It is quite light, you can move it about easily; it is only attached by two wires, so that I can do what I like with it; yet see with what facility I can drill holes in this piece of wood. Or take again this electric hoist. It is comparatively light and easily fixed, and yet by means of it we can raise tolerably large weights. It is worked by an accumulator lying on the floor, that is using only a small fraction of its power. This hoist raises weights easily, and it is a great advantage that you can raise the weights while the hoist is moved; while the only connections necessary to transmit the power are simply these quite flexible and light wires. In the case of an ordinary travelling crane, worked by a steam-engine, whenever we want to move, we have to move both engine and boiler, because they are all one. Now, experiment shows that you can get in this way electrical power at the rate of about one horse power per 50 lbs. dead weight only in the electro-motor. Hence the enormous advantage possessed by the electro-motor for travelling machinery. Let us turn our attention to our storage of power converted into mechanical work by the agency of electricity. I said that telegraph engineers mainly employed the potential energy of separated zinc and oxygen, but such a store is by no means an economical source of power, because the *maximum* amount of work obtained out of burning a certain quantity of zinc is only about 1-200th of the maximum of work to be got by burning an amount of coal of the same pecuniary value. The energy of coal is what we have to employ, if we drive steam-engines or gas-engines. It is all the store we draw upon when we use electro-motors, that is, coal will be put into the furnace to produce mechanical motion. The motion of the engine will work the magneto machine or the dynamo machine, producing an electric current, which may be transmitted to any distance that you find requisite. [The lecturer here showed how power from a gas-engine could be transmitted to the distant wall of the building in order to turn a wheel.] He continued: Small variations in the speed of the engine or the dynamo machine can be avoided by having a heavily-rimmed fly-wheel on the engine or on the dynamo machine; and in fact dynamo machines driven with gas engines are fitted usually with such a heavily-rimmed fly-wheel, turning at the rate of about a mile a minute or so, in order to keep up a uniform speed. We may use such a machine for any kind of power, or to produce an electric light. Of course if a strap breaks, or the steam is allowed to go down, it is impossible to keep it up. To avoid such mishaps, what we want is some sort of electric accumulator—some sort of reservoir that will suck in the electricity when the engine is working best, and give it out when it is tired. Again, apart from accidental fluctuations of the engine, or total breaking down of its apparatus, there is another enormous importance for electric accumulators. The uses of electricity in this country at present are very much in the same state that Robinson Crusoe was in reference to his clothes. Every man has to manufacture his own electricity, that is, if he wants any; but were there companies actually supplying it as they supply water or gas; then they could lay on the wire, and we could turn on our electric light with as little hesitation as we turn on the tap of the water pipe. The greater part of the gas burned in London is burned, probably, between 6 and 11 p.m., that is during five hours out of the twenty-four; but the gas-works are always working, so as to keep up the store in the gasometers. If in the absence of stores for gas it were necessary to make all the gas that is required between the hours of 6 and 11, then the gas-works would have to be very much larger and more costly, the capital sunk in them would have to be very much greater, and the price of gas, therefore, would be very much higher. And so it must be with electric lighting. But if only we can arrange so that the electric power can be accumulated, so as to be ready for the time when we actually require it—if it had to be supplied at the same time that it is being burned, the dynamo machines must be larger, the cost very much greater, and therefore the price of electric lighting proportionately higher—that is, if the electric energy could be manufactured during the day, and stored till required at night. The experience of the last few years has shown that the lighting of large buildings by electricity is even now more economical than by gas. What will it be when we can manufacture our electric energy—when we can store it and keep it by till we want it? Now the earliest form of electric accumulator is simply a voltameter worked backwards. If two plates of platinum be dipped into dilute sulphuric acid, and there is a current sent from one of the plates to the other, as they are placed upright and parallel to each other at

a moderate distance, the result is that hydrogen is put on the one plate and oxygen on the other. Previous to your sending a current through the voltameter, it had no power of acting as a battery, but after sending a current, a difference is produced in the two platinum plates; it coats one with oxygen and the other with hydrogen.

We have here a rough galvanometer to connect with an ordinary voltameter. I attach it to the voltameter, and show that the mere passage of the electric current from the liquid has endowed these plates with the power of acting as a battery. Now, the two platinum plates cannot store electric energy, because the operation of the current sent through the liquid produces oxygen and hydrogen, which go off in the air, and only very little stays on the plates. Grove found that by coating the platinum plates with what is called platinum black, the storage of electric force could be very much increased. We want to get a good store of electricity for a galvanic cell. Let there be sent a strong current through a short wire. It is absolutely necessary that the resistance of the cell should be very small, that is, the plates must be very near together. One of the reasons why the grooved cell will send such a much stronger current through the short wire than the Daniell cell, arises from the fact that the plates in the one are so very much nearer than the plates in the other. If you place them very near together you must have a porous partition to keep them apart, because if you do not the two liquids will mix. For example, go back to the voltameter: if you put your two plates so close together that the resistance of the voltameter when used as a secondary battery is to give a current which, by itself is very small, the oxygen given off at the one plate and the hydrogen at the other will mix together, and the liquid will be practically the same between the two plates, for it will become saturated pretty nearly with the same amount of oxygen and hydrogen, and there will be little reason why the current should pass one way more than the other. We must, then, if we put the plates near together, have a porous partition. We can get rid of this partition if we can arrange our secondary battery so that when you send a current through the battery the same substance is put on the one plate on both sides, which has no tendency to wander or go to the other. It is clear that since the liquid is in the cell the substance must be solid; and, secondly, it must not be soluble in the liquid. We must then arrange matters so that the sending of the current through the battery for the purpose of charging it shall be some form of solid which is not soluble in the liquid employed. The oxides are such substances, and for that reason lead plates were mostly used in secondary batteries, because the sending of the current through the liquid from one plate to another produces an oxide of lead. In order to have a large storage power the plates must be very large, in addition to being very near together; and to avoid their being hopelessly cumbersome, the plates ought to be made in a spongy condition, because if you have spongy lead on each side, the surface may be very large, and the practical area may not be so enormous. We want, then, two plates near together, and formed of some spongy material. Now, Planté, who has worked most assiduously on this subject for years, made a spongy lead plate by a very simple process. He took two ordinary lead plates, put them in a liquid, and passed a current through one to the other. The effect of doing that is to deposit oxide of lead on one plate and to put free hydrogen on to the other. This went on for a certain time, and then he discharged the battery, which was then very weak indeed. He now reversed the process. He sent the charging current to put the peroxide on the other plate, and again he discharged it. That kept on for longer and longer time, and giving the plates longer and longer intervals of rest, and by this process after some months he was able to get a cell which had a fair amount of storing power. The great and main disadvantage was the enormous time which it took to make a cell; and, secondly, the storing power, though respectable, was not anything very great. In the year 1880, Faure thought of the idea of taking lead plates and covering them with tolerably thick layers of ordinary red lead, and then put them in little flannel jackets. He put them near together in boxes, of which I have many specimens, and every alternate plate he connected together, so that there was a large surface of plates very near to each other. The peculiarity of this red lead is that by sending a current through it it is very easily turned into spongy lead; the charging operation is performed in the same way that, with slight modifications, Planté did it. First in one direction for a certain time it changes the red lead into peroxide of lead, and on the other side into a very slight oxide of lead. But this changes the process, and the peroxide is turned into a very slight oxide, and that very slight oxide into peroxide. But the great difference is that in the one case you are dealing with months, and in the other you are dealing with days or possibly hours in forming the cell. The enormous amount of time necessary to make the Planté cells prevented them becoming of any commercial value. I should mention that when the cell is formed, and you want to charge it, what you do is this: you send a current through the cells in the same direction as the last current sent, and this has the effect of reducing the suboxide on the one side to pure lead, and make the peroxide on the other slightly more oxidised. Discharging the cell is simply reversing what is done in charging, that is, a small amount of oxygen travels back; therefore the simple action of charging consists simply in the travelling backwards and forwards of a small amount of oxygen. Now, does such a cell store electricity? Certainly not. Because when you charge one of these cells, just as much electricity goes out at one end as goes in at the other; and conversely when you discharge it. What do they do then? They do not store electricity, but electric energy, which is quite a different thing. Take the case, for instance, of a stream of water turning a water-wheel, which is employed in raising up corn into a granary. That is the storage of corn, but you would not call that the storage of water. Though electricity passes through the cells, and although when you discharge it the electricity passes out, the cell does not store electricity but electric energy; in fact, storage of electricity is just as much a misnomer as storage of force.

The next point to consider is, first, what is the storing capacity of one of these cells? secondly, what is its efficiency? that is, how much power can you get out of one compared with what you put into it? Thirdly, what is its durability? Luckily, I am able on this subject to give you something more than mere hearsay, because Professor Perry and myself have been engaged in some experiments on this question. Take one of many examples as to the storing capacity of a cell. The discharge of a certain cell, which contained 81 lbs. of lead and red lead, lasted for eighteen hours, six hours on three successive days, and the total amount of work we got out of it was 1,440,000 foot-pounds; that is, about one horse-power exerted for three-quarters of an hour, or about 18,000 foot-pounds per pound of lead or red lead. In connection with this storage, a very curious phenomenon, which has not received the attention it deserves, came under our notice, and that is the peculiar recuperative power that the cells possess. The omission to observe this is very likely to lead observers to totally wrong results as to their efficiency. You take a cell, charge it, and measure the work put in. Discharge it rather rapidly, till you find no current at all. You may think that you got off not a very large percentage of the total work due from the cell, and you put it by as a bad one. But let it sleep a little; wait, and it will become marvellously invigorated; in fact, it will become quite equal to a new charge. Try it again; it will begin to give off power probably more rapidly than when you began. A certain cell that we hastily discharged until, apparently, it was entirely discharged, gave off three times as much work when we tried it again as at the first discharge; and this particular cell, upon one occasion, when we had discharged it down to two or three ampères, when we tried it again, the discharge was found to be equal to fifty ampères, which is far stronger than is used in any system of electric lighting. On the first day on which we discharged it, the cell had its electricity discharged very rapidly, and the consequence was that the energy was given off perfectly regularly. The next day we took out the energy more quickly, the third day more quickly still, so that in the first three hours on the third day far more energy was given off than in any hour during the first or the second. We managed that by reducing the external resistance; in fact, by doing so you can discharge practically as fast as you like. You can make it two or three ampères, or 200, if you wish it.

Next as to the efficiency—that is the relation of the work put into the cell to the work given out. And here again the experimenter must be very cautious. When you send a current through anything you necessarily heat it. If you charge one of these cells very rapidly you will heat it, and there is a certain amount of power wasted in heating the cell. If you discharge it very rapidly you will heat it also, and the amount of power it can give externally is partially spent also in heating the cell. It is quite possible to find out by experiment how much power you are putting into the cell, which is usefully employed in producing chemical decomposition, and how much is thrown away in heating the cell. In discharging, also, you can find out how much of the total power is wasted by a hurried discharge. Allowing for this, we found that if the charge is about 1,000,000 foot-pounds, and the discharge has a mean value of about 17 to 20 ampères, the loss of power in charging and discharging need not exceed more than about 18 per cent.; that is to say, you can get about 82 per cent of the power you put in, which is an enormously high efficiency. I may mention that when we commenced the investigation we were rather sceptical about the results we had seen published. The thing appeared to be too good, and it was only after our own experiments that we found that what we had read was not an exaggeration. It is quite possible that the loss will not exceed about 18 per cent. if the charging and discharging be not too hurried, and under a somewhat slow discharge the total loss was only about 10 per cent., or 90 per cent. of what was put in came out again. As regards durability, experiments over two months did not show us any evidence of deterioration, so for that time certainly the cells did not spoil, and therefore they probably did not spoil for a much longer time, as there was no signs of deterioration then. I have said that a cell containing 81 lbs. of lead gave off 1,440,000 foot-pounds of work. Consider what that means. That amount of work means sufficient to draw a car containing 46 passengers about two miles. If you ask me whether they use one cell in a tramcar as it is now practically driven, the answer is, they use more. The reason is that the electro-motor is not suited specially to the accumulators, nor is the gearing suited for them. The cells as at present made will not give off their energy as rapidly as is necessary to completely discharge one of the cells in a short time, and the consequence is that more cells have to be used. But, on the other hand, a ton of such cells would be necessary to drive a tramcar for 50 miles. Spacious as this lecture theatre is, it is fortunately not large enough to bring a tramcar in, and so we have to content ourselves with the next best thing. To prove that the cell really does contain large quantities of power, we will do some sawing by means of the energy in the cells which I have here before me. We are going to saw by coal burned yesterday on the other side of London. Electricity was produced, put into the cells, and brought to this place yesterday, and we are now going to get it out by means of the electro-motor. [The experiment of sawing was here successfully performed.] We can also obtain electric light through our store of energy. But just as ordinary electro-motors are not made specially to work with these cells, and although one of these cells contains enough power to produce 1,500 candle-power for 30 minutes, the ordinary lamps will not give that. In fact, an ordinary lamp would give you no light at all with this cell, because the lamp is not made to discharge it with sufficient rapidity. Just like a man having a good deal of money at the banker's, but he cannot get it out quickly enough, and so he may even be bankrupted. Mr. Edison has been turning his attention to this question, and here is his handiwork, which only arrived last night from America. He has lamps specially made to work with only one or two of the cells of a Faure's accumulator. [The experiment was here made of lighting Edison's lamps. It was brilliantly successful, and the lecture theatre

was beautifully illuminated, the audience cheering its success most enthusiastically.] One of these lamps, as you see, can be moved about with the greatest facility. We can apply different power to them—2, 3, 4, up to 12, or a higher number of candles. The ordinary lamps require electromotive force. Maxim's required a great number of cells. You may be surprised when I talk about measuring the power of the lamp in foot-pounds. How do we get it? Well, it is very easy to understand. Supposing you have a stream of water turning a wheel, the power depends upon two things; first, how much water is flowing; secondly, the height from which it is falling. It depends, in other words, on the flow and the head. Exactly in the same way the power put into this motor depends upon two things, on what we call the potential or electromotive force between the two ends of the wire, and on the quantity of electricity passed through it. I am going to make one or two very short experiments to measure these two things—what will be the equivalent in water to the quantity of water falling down, and the height from which it is falling. We have, so to speak, two streams here, and we want to know the quantity that is flowing, and the difference of pressure between the terminals of the machine. At present the machine is at rest, intentionally; and on our scale we find 15 for quantity and 11 for the potential. The quantity of electricity passing according to a special unit is 15; the difference of pressure is 11; the work now, then, is being all spent on heating the wires. We now let the machine work slowly, and we find that the two readings are reduced respectively to 10 and 16. Now the work done depends on the product of the two. Now set the machine to work very rapidly. The current is now reduced to 4 and the electromotive force becomes 23. Now what does that tell us? It tells us something of enormous importance. The waste of power depends on the square of the current; whereas the work depends on the product of the electromotive force and the current. The waste of power after heating is proportionate to the waste of power from electric friction. Here, then, we have the three cases of 15^2, 10^2, and 4^2. The total power put in in the first case is 10 × 16, or 160; and the total power in the latter case is 4 × 23, or 92. In the case when the motor was running slowly the waste of power in heating bore to the waste of power when it was running quickly the ratio of 10^2 to 4^2; *i.e.*, 100 to 16, or about eight times as much work was produced when it was running slowly as when it was running quickly. What does that tell us? If we want to transmit power economically we must deal with small currents on the one side, and on the other with very large electromotive force. We must have very small currents in our wires and very large electromotive force, because the waste of power is proportional to the square of the current flowing, whereas the energy put in is proportional to the product of the two. We can make the produce of the two as large as we like, and the current as small as we like; in fact, if we have a generator producing electricity, and want to send that electricity to some distant place as economically as possible, the current through the wire should be extremely small and the electromotive force must be very great. Sir William Thomson has calculated that in order to transmit the power of Niagara economically to, say New York or Philadelphia —that is 21,000 horse-power;—if you want to reduce the loss of power to only 20 per cent., that is to say, get 80 per cent. out of the power with which you started, then you must have an electromotive force of about 80,000 volts. You can fancy asking Mary Jane to dust a wire which was transmitting 21,000 horse-power: it would be like telling her to keep a flash of lightning tidy. Last year, at the Society of Arts, Professor Perry pointed out how much would be gained if instead of taking coal from the coal mines you took your engine to the coal and transferred the power by electricity; that is to say, why not place your steam-engine at the top of the coal pit, or even at the bottom, or why not in the seam itself? You can transmit power by two flexible wires just as easily down a mine as down a street. We shall probably have engines driven by coal at the mine some day, as pointed out by Professor Perry last year, and to transmit that power economically will require very high electromotive force in a small current, but with a great difference of potentials between the wires. When you use this power commercially, the Faure battery will solve that question, and probably, although Professor Thomson pointed out that it had not yet attracted much attention, that is the most important of all the uses of secondary batteries. We have got a wire at an enormous difference of potential, and we want that wire to give out at its other end a little of its power for various purposes. How can we possibly do it? Arrange secondary batteries in series, as arranged on this floor, and let a current charge this battery of secondary cells. When you have charged them, simply take, say, 50 of them, and connect the two extremes with two wires: thus you will have a great difference of potential between the two points. When you take these cells away the current perhaps will be only a matter of 100 volts, which is quite a manageable electric force. The secret is to send a weak current with a great difference of potential through an enormous series of secondary batteries at the place where you want to convert the electricity into mechanical work. And then in succession attach the batteries in series of 20 or 30, or 40 or 50, and you will have no difficulty in attaching the two ends, because there is comparatively a small difference of electromotive force, though there is a considerable difference in each of the cells taken individually. It enables us, in other words, does that Faure battery, to reduce this enormous force into commercial value.

So far we have been dealing with things that can be improved by the use of secondary batteries. I now come to the last use which I shall consider to-night, and it is the use of the secondary battery in performing a result which can only be performed by such a battery—the lighting up of a train in motion. If you require that the motion of the train shall light it up, you must have a store of electric power, because if you use a dynamo machine, when the train stops the dynamo machine necessarily stops too. That is what happens if you have dynamo attached to the axle of the wheel, and by that means producing the electric light. But if you use secondary batteries, and if you come to a station, then the electric power produced by the dynamo is stored up, and can be given out so as to avoid leaving the train in darkness. In fact, the Faure battery could act as a sort of fly-wheel, taking in the power when the dynamo is working and giving it out when it is not. This is practically being done on the Brighton Railway, and to show you that we can really produce electric light by storage, I have in this theatre arranged 50 lights, which would correspond with four lights per carriage to twelve carriages. We will now light them up, and you will see by that how easily it is done and how completely it will answer the end in view. The former uses of the secondary battery are uses which are only important now in a secondary degree; the uses for which we now employ it render electric light in trains perfectly possible and practicable, which was under old conditions quite impossible.

ON THE MEASUREMENT OF THE AVERAGE RESISTANCE OF A GROUP OF BATTERIES.

IT is often requisite to know the value of the average resistance of a group of batteries of the same kind; for example, to know what is the average resistance of a Leclanché element of a type of which we possess a series. Mr. J. Pollard solves this problem in the following manner. Let us take, for example, three elements of the same nature, with unknown electromotive forces, E_1, E_2, E_3, and with internal resistances also unknown, r_1, r_2, r_3. Let us first oppose (fig. 1) $E_3 + E_2$ to E_1, and by means

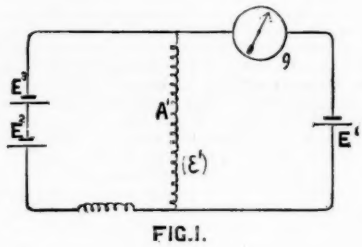


FIG. 1.

of a suitable derivation current, A_1, let us reduce the sum of the two former so as to equalise the electromotive forces, and render immovable the needle of the galvanometer, *g*, placed in the circuit (Poggendorf's method for the comparison of electromotive forces). Let us then add any resistance, 10 ohms for example, to $r_2 + r_3$. In order to establish equilibrium we must add to A_1 a resistance ϵ_1. Applying to these two operations the formula of Poggendorf's method, we have:

$$\frac{E_2 + E_3}{E_1} = \frac{(r_2 + r_3) + A_1}{A_1} = \frac{(r_2 + r_3 + 10) + (A_1 + \epsilon_1)}{A_1 + \epsilon_1}$$

Deducing from the two last equations the value of $r_2 + r_3$, we have:

$$r_2 + r_3 = A_1 \frac{10}{\epsilon_1}$$

In the same way, by changing the grouping of the batteries, and repeating the two operations indicated above, we obtain:

$$r_3 + r_1 = A_2 \frac{10}{\epsilon_2}$$

and

$$r_1 + r_2 = A_3 \frac{10}{\epsilon_3}$$

Taking the sum of the three equations, we get:

$$2(r_1 + r_2 + r_3) = 10\left(\frac{A_1}{\epsilon_1} + \frac{A_2}{\epsilon_2} + \frac{A_3}{\epsilon_3}\right)$$

Whence the value of the mean resistance

$$r_m = \frac{r_1 + r_2 + r_3}{3} = \frac{10}{6}\left(\frac{A_1}{\epsilon_1} + \frac{A_2}{\epsilon_2} + \frac{A}{\epsilon_3}\right)$$

The above double operation, repeated with the three methods of grouping, also enables us to write :

$$\frac{E_2 + E_3}{E_1} = 1 + \frac{10}{\epsilon_1} = a_1$$

$$\frac{E_3 + E_1}{E_2} = 1 + \frac{10}{\epsilon_2} = a_2$$

$$\frac{E_1 + E_2}{E_3} = 1 + \frac{10}{\epsilon_3} = a_3$$

We then obtain the relations :

$$a_1 + a_2 + a_3 + 2 = a_1\, a_2\, a_3$$

and

$$100\,(\epsilon_1 + \epsilon_2 + \epsilon_3) + 1000 = 4\epsilon_1\, \epsilon_2\, \epsilon_3$$

And these relations give in addition to the mean resistance the three equations :

$$\left(\frac{E_1}{\frac{1}{1+a_1}}\right) = \left(\frac{E_2}{\frac{1}{1+a_2}}\right) = \left(\frac{E_3}{\frac{1}{1+a_3}}\right)$$

which is interesting to know.

If the three electromotive forces be equal, *i.e.*, if $E_1 = E_2 = E_3$, we shall then find that $a_1 = a_2 = a_3 = 2$, and $\epsilon_1 = \epsilon_2 = \epsilon_3 = 10$.

We get besides :

$$r_2 + r_3 = A_1$$
$$r_3 + r_1 = A_2$$
$$r_1 + r_2 = A_3$$

and finally :

$$r_m = \frac{A_1 + A_2 + A_3}{6}$$

When we employ a resistance box with a Wheatstone bridge we arrange the apparatus as is shown in fig. 2. We place E_1 at the usual place for the galvanometer, and $E_2 + E_3$ at

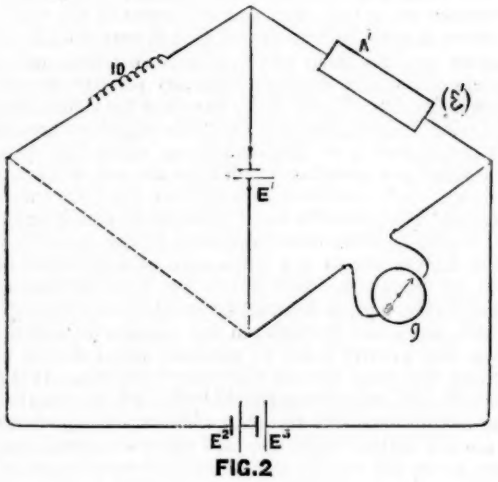


FIG.2

that for the battery. The galvanometer, g, takes the place of the resistance to be measured. The rheostat forms the shunt ; we take 10 in one of the proportional parts, whilst the other side is infinite.—*La Lumière Electrique*, March 4th, 1882.

NOTES.

GALVANOMETER WITHOUT RESISTANCE INTENDED FOR THE MEASUREMENT OF INTENSE CURRENTS.—By MM. Terquem and Damien.—This apparatus consists essentially of, 1, a surveyor's compass, below which is fixed a band of copper of 0·01 mètre in breadth, in which the current may circulate, an arrangement often adopted to show the passage of a current ; and of a sort of prism formed by the union of rectangular pieces of wood of the same dimensions as the compass, having each the same thickness : below each plate is a band of copper parallel to the first one. Four rods fitted with pins completely connect the compass and the plates. At the centre of the base of this rectangular prism is fixed a cylindrical wooden rod, which penetrates into a fixed foot, and allows the compass to revolve on its centre. Springs placed on the foot in connection with the conductors in which the current circulates bear upon two semi-cylindric plates fixed upon the central stem, and separated one from the other by a slight interval. From these cylindric plates proceed vertical conductors to the horizontal plates in the thickness of the prism : the movement of a peg turns the current into one or the other band. This apparatus can serve equally well as a tangent and as a sine galvanometer. If we wish to use the sines, after having turned the apparatus so as to bring the needle to zero, the current is interrupted. The deviation of the needle gives the rotation of the apparatus, and the sine of that angle shows the intensity. With the sine galvanometer in common use, if the current is too strong we cannot always bring the needle to zero. With this apparatus we can always succeed by taking a band sufficiently far from the needle. Thanks to this arrangement we may, besides, easily graduate the apparatus if employed as a tangent galvanometer. The advantages of the apparatus are the simplicity of its construction, the possibility of changing the circuit so as to obtain deviations comparable with currents of very variable intensity ; the ease of reading off, and of bringing the needle to zero in consequence of the absence of any circuit above the needle. Lastly, the graduation in absolute value may be made with the machine itself without using rheostats or shunts. By placing two bands crosswise below the compass, it may be converted into a differential apparatus. If used as a tangent galvanometer it serves to measure currents the intensity of which varies from $\frac{1}{10}$ ampère to 20 ampères. The authors consider that with a better constructed apparatus it will be possible to determine quickly and with a certain exactness the horizontal intensity of terrestrial magnetism.—*Comptes Rendus.*

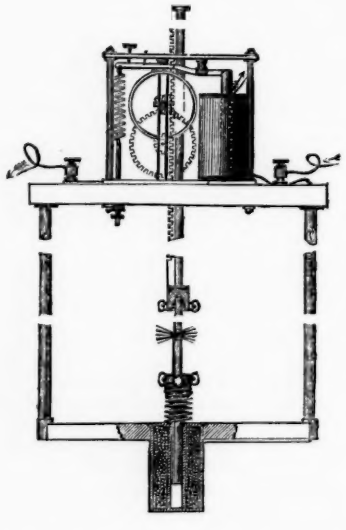
M. DESCHÆMER, in his experiments with flowing liquids, finds a direct analogy between hydrodythamic phenomena and those of electro-magnetism and induction. M. Bjerknes, experimenting with bodies vibrating in water, finds everywhere an inverse analogy, imitating the phenomena of static electricity and magnetism.—*Comptes Rendus.*

ON THE PRACTICAL SOLUTION OF THE PROBLEM OF TRANSFERRING POWER TO GREAT DISTANCES.—M. Maurice Levy.—The author, in a memoir presented to the Academy of Sciences, examines the possibility of transferring to any distance a fixed quantity of energy obtaining a given yield as near unity as is wished under the two-fold conditions of not exceeding a given electromotive force—a condition without which there is no insulation—and of employing merely machines commonly used in the arts, such, *e.g.*, as those of Gramme or Siemens, even of the smallest kind. He answers the question in the affirmative.—*Comptes Rendus.*

ELECTRIC LIGHTING IN AMERICA.—Electric lighting is being extensively and successfully introduced in St. Louis and throughout the State of Missouri. The majority of the lamps used are those of Mr. Heisler, which are worked with alternating currents. The lamps are said to be of a very simple character, and are automatically adjusted by the strength of the current. This system of electric lighting has been introduced into the following places amongst others :—The Southern Hotel, Luidell Hotel, Mo. Pacific Freight Depôt, Olympic Theatre, Grand Opera House, Republican Building, St. Louis Refrigerator and Wooden Gutter Company, St. Louis Grain Elevator, several transfer boats, &c., &c. Mr. Heisler also claims that he can produce successfully lamps with a very small arc, and that from one of his ordinary 6-light machines, weighing 750 lbs., he has produced and kept in operation from 24 to 36 lamps using $\frac{1}{4}$ diameter carbons. For the installation of his system, Mr. Heisler uses separate wires for each lamp. One

main conducting wire is employed, but the return from each lamp to the machine is separate, and this principle, it is claimed, practically solves the great problem of dividing the lights without an increase in the strength so vastly out of proportion to the increased number of lights as to make small lamps too expensive to be used in competition with gas.

ELECTRIC LAMP.—Filed in the United States of America Patent Office, March 1st, 1881, No. 253,205. Alfred G. Holcombe, Danielsonville, Conn., assignor to the Standard Electric Light Company, New York. (No model.)



Claim.—1. In a feeding device for electric lighting apparatus, in combination, a brake-wheel actuated by the gravity of the carbon-holding rods by means of suitable connecting-gearing, a lever provided with a narrow-edge contact-shoe, caused to bear on the periphery of the brake-wheel by means of an adjustable spring, a stop device to govern the extent of movement of the lever, and an electro-magnet adapted to move the lever away from the brake-wheel and against the stop device, substantially as and for the purpose set forth.

2. In an electric lighting apparatus, an axial magnet included in the branch circuit of the lamp which is always closed, the movable core connected to the brake-lever, a brake-wheel actuated by a rack on the upper-carbon-holding rod, an adjustable spring for causing the lever to bear on the brake-wheel, and the upper carbon adapted to feed down by gravity when the axial magnet raises the lever off the brake-wheel, in combination with the lower carbon, its holder and supporting-spring, the core of an axial magnet, and the axial magnet, the whole of which, with the upper carbon, constitutes the main circuit of the lamp through which a part of the electric current flows to form the arc between the ends of the carbon rods when the lower carbon is depressed by the action of the axial magnet on its core, substantially as and for the purpose hereinbefore set forth.

SOCIETY OF TELEGRAPH ENGINEERS.—At the meeting which was held, at 25, Great George Street, Westminster, on Thursday, March 9th, at 8 p.m., a paper was read on "Measurements in the Medical Applications of Electricity," by Drs. W. H. Stone, M.A., and W. J. Kilner, B.A.

QUEENSLAND TELEGRAPHS.—We have just received from Australia a card of Christmas and New Year's greeting sent by Mr. Matveieff on behalf of the officials of the Post and Telegraph Department of Queensland. Mr. Matveieff is the superintendent of electric telegraphs. The card bears several statistical matters of interest. Queensland was established as a colony in 1859. In 1860 the population was 28,056, and in 1880 it had increased to 226,077. In 1880 the telephone system was introduced. In 1860 the number of miles of telegraph lines and wires was 169, and in 1880 the amount of mileage of line was 5,768, and of wires 8,149. In the same respective years the number of telegraphic messages transmitted and received were 6,189 and 574,445 respectively.

TELEGRAPH CLERKS.—In the House of Commons, on February 28th, Mr. Macliver asked the Postmaster-General whether, in applying his recent scheme for improving the position of the telegraph clerks, he was aware that an undue proportion (75 per cent.) of the superior appointments had been given to postal clerks of limited service, while telegraph clerks of fifteen and twenty years' service had been passed over? whether he would endeavour to allay the dissatisfaction which such alleged partiality had occasioned? and whether the delay in applying the scheme to Bristol and Plymouth could not be shortened?

Mr. Fawcett.—In reply to my honourable friend I have to state that when the scheme which was sanctioned last year for improving the position of the postal clerks and telegraphists with regard to pay and promotion came into operation it was necessary to introduce a new classification into every post-office in the United Kingdom where an established force was employed. This has necessarily been a work of much difficulty and complexity. Many hundreds, I may say thousands of promotions have had to be considered; and I can with confidence assert that there has been no intention whatever of doing the slightest injustice to the telegraphists, but that in every instance the claims arising from seniority and fitness have been most carefully weighed. With regard to the latter part of the question, I may say that the scheme for the new classification of the Plymouth post-office has been already sanctioned, and the scheme for Bristol will be in the course of a few days.

THE HORNSEY RAILWAY ACCIDENT.—Major Marindin, in concluding his report on this accident to the Board of Trade, says:—"The lesson to be learned from this fatal collision is that the whole system of fog signalling in use generally throughout the kingdom is a very weak point in railway working, and that the rules for working under the present system, weak as it is, require improvement. Even when fog signalmen are at their post, and are known by the drivers to be there, it must be remembered that in very thick fogs the fogman and his lamp are frequently invisible, and that, therefore, a driver does not get any positive intimation when a signal is off, such as he has when the signal lamp or arm is itself visible, but only a negative signal, on account of the non-explosion of two detonators, which may possibly have failed to explode, although upon the rail, and intended to do so. It is therefore evident that the rule enjoining 'caution' when running in a fog should be rigidly enforced, and it might well be more explicit in laying down at what speed drivers are to run when approaching signals under such circumstances. But if the risk be appreciable at all times during fogs, it becomes far greater when the fog is a sudden one; and it should, in my opinion, be clearly laid down that a driver is not to pass any signal during a fog without satisfying himself that it is off for him. It is most desirable that some means should be devised by which drivers may be informed with certainty whether fog signalmen are or are not at their posts, and that where the signal arm and lamp are at any considerable distance from or height above the line, a lower arm and strong reflecting lamp should be provided, as nearly as possible at the level of the driver's head."

There is evidently room for the exercise of some inventive talent in this direction.

INTERRUPTION OF COMMUNICATION BETWEEN SHETLAND AND THE MAINLAND.—After an interruption of ten days telegraphic communication between the mainland and Shetland was restored on the evening of the 24th ult. From another note it will be seen the inhabitants of Lerwick are again pressing on the Postmaster-General the necessity for direct communication.

THE TELEGRAPHIC INTERRUPTION.—A public meeting was called on the 22nd ult., by the magistrates and Town Council of Lerwick, to consider the interruption which has occurred in the telegraphic communication. The meeting

was well attended, and was presided over by Major Cameron, chief magistrate of the burgh. Major Cameron said that, as all were doubtless aware, the telegraphic communication with the mainland was again interrupted, by the breaking of the Stronsay Firth cable; and after the experiences of last year, all knew what a serious thing this would be for the mercantile community if it were not immediately restored. If they were silent, and took no steps to have the matter brought under the notice of the Postmaster-General, he would doubtless think the inhabitants of the islands were satisfied with the present arrangements, and this meeting had therefore been called for the purpose of taking action in the matter. The following resolutions were then put to the meeting and unanimously adopted :—

1. That the renewed interruption of the telegraphic communication with the mainland, by the breaking of the Stronsay Firth cable, less than four months after communication with Shetland had been restored, is in the opinion of this meeting a convincing proof of the necessity for a direct cable between Shetland and the mainland of Scotland.
2. That until they are provided with a reliable means of telegraphic communication, the inhabitants of Shetland are deprived of benefits to which, as taxpayers, they have a just and undoubted right.
3. That this meeting protests against the principle asserted by the Postmaster-General, that each local line ought to be self-supporting, and is of opinion that even if it were a fact that the Shetland cable is unremunerative, the cause of this is the want of public confidence engendered by the constant and annoying interruptions in the communication, and the large sums of money continually being expended in repairing so many lines.
4. That the interests and industries of Shetland, which suffered so severely last year owing to the interruption in the communication, and the long and inexplicable delay which occurred in the repairing of the cable, are again still more seriously threatened by the breaking of the Stronsay cable, at this season of the year; and that, in the meantime, immediate steps should be taken to have the present line put into working order.
5. That a copy of this resolution be forwarded to the Postmaster-General.
6. That copies of the above resolutions be sent to the Hon. J. C. Dundas, M.P., Lord-Lieutenant of the county, Mr. Laing, M.P. for the county, and Sheriff Rampini; and that Sheriff Rampini, who is leaving for London to-night, be requested, in conjunction with the Lord-Lieutenant and the member for the county, to take such steps as they may think right to bring the matter under the notice of Parliament.

A vote of thanks to the chairman for presiding brought the meeting to a close.

LEITH TOWN COUNCIL.—At a meeting of the Paving Committee of this Council, held on the 16th ult., it was resolved to petition against the Tramways Mechanical Powers Bill and the Electric Light Bills. A reply was read from the Tramway Company regarding the remonstrance sent to them as to the present mode of collecting fares, but as the letter was considered unsatisfactory, the Clerk was instructed to again bring before the Tramway Company the danger and inconvenience to passengers arising from the system of collecting fares.

DUNDEE—THE THREATENED OPPOSITION TO THE ELECTRIC LIGHTING BILL.—A special meeting of the Dundee Gas Commissioners was held on the 16th ult.—Provost Moncur in the chair—to consider the threatened opposition of the Northern Electric Lighting Company in Dundee against the Gas Commissioners' Bill to light the town with the electric light. It was stated that the Commissioners did not intend to prevent any private firms from making and using in their own works the electric light, but that they desired to have the exclusive power to supply the town generally with the electric light, as they had at present in supplying the town with gas. To this power the Electric Lighting Company objected, and threatened to oppose it in Parliament. After fully considering the matter, the Commissioners resolved to insert a clause, providing that private firms could make and supply their own light, but to request exclusive power to light the town generally, so as to prevent any private company coming in between the Gas Commissioners and the community to supply the electric light.

KINGHORN—THE ELECTRIC LIGHT.—On the 23rd ult. the building yard of Messrs. John Key & Sons was lighted for the first time with the electric light. During the building of the large steamer which was launched last Sunday a good deal of night work had to be performed—light for which was obtained by using naphtha lamps. Several vessels are now in progress, and the method of lighting inaugurated last night will enable work to go on efficiently by night as well as by day, when that is required. The dynamo machine and lamps employed are those of the Brush Light Company, and the power is obtained from the ordinary engine. The dynamo machine is one for six lights, and lamps to that number are distributed in advantageous positions about the yard. The work has been carried out under the direction of Mr. Partridge, one of the electricians of the Brush Company. The dynamo machine was set running about seven o'clock, and the light, which burned throughout the evening, gave the greatest satisfaction. Attracted by the brilliant spectacle the yard presented, a large crowd of people soon gathered to witness the experiments, which are, we understand, the first of the kind that have taken place in Fife. The men in the yard seemed to appreciate the change from the dim light of the naphtha, and worked away with redoubled vigour.

BUENOS AYRES AND BELGRANO TRAMWAY COMPANY, LIMITED.—Capital: £250,000, in £5 shares. Objects: To take over the Buenos Ayres and Belgrano Tramways, situate in the Argentine Confederation, and also to trade in electric apparatus and machinery, and in other things used in the making, equipment, and working of tramways. The signatories (who subscribe for one share each) are as follows: —*James Goodson, 32, Kensington Park Square; *James Percy Leith, 8, Dorset Square; *H. Lee Corlett, C.E., 16, Cornwall Road, Bayswater; *T. Dickson, 123, Bishopsgate Street Within; *Lieut.-Col. H. Mollerus C. Champion, 64, Redcliffe Square, S.W.; J. W. Tricker, 2, Addiscombe Grove, Croydon; and C. W. Kirk, 148, St. Paul's Road, Camden Square. Directing qualification, 40 shares. Remuneration, £850 per annum. Registered 2nd inst. by Millett and Morse, 1, Old Palace Yard, Westminster.

WASSAWHIGHT RAILWAY COMPANY, LIMITED.—Capital, £5,000, in £10 shares. Objects: To construct a railway from Bushua to the Tacquah and Oborsoo districts of the Gold Coast Colony, West Africa, and also to construct and promote telegraphs, telephones, docks, and other works and buildings conducive to the company's interest. Signatories (with one share each):—*F. Fitzgerald, 80, Cheapside; *J. A. Beale Horton, M.D., 40, St. Luke's Road, Westbourne Park; *J. W. Johns, 90, Cannon Street; *J. Gibson Watson, H. T. Stanes, and J. G. Cowan, of 28, Fenchurch Street; and H. W. Maynard, 34, Gracechurch Street. James Irvine and Emile Bassots are also directors. Registered 6th inst. by Hollams, Son, and Coward, Mincing Lane.

HASTINGS AND ST. LEONARDS-ON-SEA ELECTRIC LIGHT COMPANY, LIMITED.—Capital, £50,000, in £10 shares. Objects: To supply light, heat, and motive power by electricity, and to acquire the right to manufacture and use telephones, telegraphs, phonographs, and electric apparatus generally. Signatories (first five of whom subscribe for ten shares each, and latter five shares each):—*H. M. Baker, *W. L. Vernon, *J. Woodhams, *J. Reeves, *J. Catt, E. W. J. Hennah, and F. J. Parsons; all residents in Hastings and neighbourhood. Directing qualification, ten shares. Registered 7th inst. by F. A. Lingham, of Hastings, solicitor.

* Signatories whose names are preceded by an asterisk are also directors.

THE TELEPHONE.—In the annual report of the Dundee Police Commissioners just published, it is announced that a few months ago telephonic was substituted for telegraphic communication between the central and four district police stations. In addition to this, telephonic communication has been established between the Central Police Office and the Harbour Offices. The Dundee and District Telephonic Company, Limited, has supplied communication between the Central Police Office and its members, 188 in number, which has been serviceable to many of them.

THE TELEGRAPH CABLE FOULED.—A foreign brig was observed on the 2nd inst. riding in Burntisland roadstead in close proximity to the cable. She lost an anchor, with 45 fathoms of chain, and had extreme difficulty in lifting her two other anchors. In bringing one of them to the surface, the old cable was found attached thereto. It was at once dropped, without receiving material damage. The vessel proved to be the German brig *Acona*, Captain Heidemann, four weeks out from Rouen for Burntisland to load coal.

THE ELECTRIC LIGHTING BILLS.—It was announced at the sitting of the Parliamentary Committee of Selection, on the 3rd inst.—Sir John Mowbray, chairman—that all private Bills in which powers for electric lighting purposes are sought will be referred to a special Parliamentary Committee.

POST OFFICE TELEGRAPHS.—The Post Office authorities have now authorised the railway companies to collect public telegrams at St. Enoch's, Queen Street, and the Central Stations, Glasgow.

ON MICROPHONIC CONTACTS IN VACUO.—According to Mr. E. Berliner, the variations in thickness and density of the strata of air interposed between the vibrating parts of a microphonic contact produce great variations in the resistance. As the resistance of a very dense carbon is not increased by pressure, the writer explains by the intervention of layers of air the fact that the resistance of a microphonic contact can amount to as much as one megohm. In order to confirm his ideas, Mr. Berliner introduced a Blake transmitter into a wooden box closed hermetically and capable of being connected with a pneumatic machine. Two metallic conductors passing through the sides of the box allowed the transmitter to be put in communication with different apparatus. The resistance of the contact was weakened by $\frac{2}{10}$ upon the formation of a vacuum. However, when the microphone was connected with a battery element in the primary circuit of an induction coil, the secondary circuit of which included a telephone, the intensity of the sound transmitted was the same when the transmitter was in the air as when it was in a vacuum. In the *Zeitschrift für Electricität* it is remarked that the manner in which the two carbons are placed one upon the other must also influence the resistance of the contact. The resistance of the air taken by itself ought to vary, as in the electric arc, in inverse ratio to the intensity of the current.—*La Lumière Electrique*, March 4th, 1882.

THE ASSOCIATED CHAMBERS OF COMMERCE.—London, Thursday, March 2nd. The annual meeting of the Associated Chambers of Commerce was continued and concluded today at the Westminster Palace Hotel, under the presidency of Mr. Monk, M.P. In opening the proceedings, the chairman said he had received two important letters, which he desired to read to the meeting. The second letter ran as follows:—

General Post Office, London, March 1st, 1882.

SIR,—I am directed by the Postmaster-General to inform you that he has had under consideration your letter of the 14th December last, transmitting a memorial from the Associated Chambers of Commerce of the United Kingdom, urging Her Majesty's Government to enter into negotiations with foreign Governments and the Colonies for the purpose of cheapening and facilitating telegraphic communication. Barely two years ago a very considerable reduction was made in the charges for international telegrams, and the public were afforded the advantage of a word tariff; and the question of a further reduction in the rates cannot be reopened before the next International Telegraph Conference takes place, in 1884. As showing the amount of the reduction made at the last Conference, Mr. Fawcett would observe that in the case of the three countries mentioned in the memorial—namely, France, Belgium, and Germany—the reduction of tariff was as shown below, and in the case of other countries a corresponding reduction was made. In the case of France the former average cost per message was 4s. 4d., the present cost 2s. 11d., being a reduction of 33 per cent.; Belgium—former cost 3s. 4d., present cost 2s. 2d.—a reduction of 35 per cent.; Germany—former cost 7s. 4d., present cost 3s.—a reduction of 59 per cent. Mr. Fawcett is fully alive to the importance of facilitating international communication in the direction sought by the memorialists, and the question of the possibility of making any further reduction would no doubt come under review at the next Conference, by which time experience will have been gained of the working of the tariff at present in force.

I am, &c.,

C. H. B. PATEY.

ELECTRIC TRAMWAY CARS.—The first application of electricity to the driving of tramway cars in this country was made on Saturday, at the works of the North Metropolitan Tramways Company, Leytonstone. The car employed was one which has been the subject of a similar experiment in France. It was fitted with a large number of Faure accumulators, ranged under the seats and communicating with a motor underneath, which, in its turn, by means of pinion-wheels, acted upon the wheels of the car. The accumulators having been charged at a dynamo machine in the company's yard, a number of ladies and gentlemen who had been invited to witness the experiment mounted upon the car, and had a few runs with it up and down a quarter of a mile of tramway in Union Road, to the amazement of the inhabitants, who, for the first time in their lives, saw a tramcar full of people travelling at the rate of seven or eight miles an hour without any visible motive power. The accumulators, which weighed a ton and a half, exerted, with one charging, a force equal to that of 25 horses for one hour—that is to say, five horses for five hours, and so on. In other words, the car could have run with its full number of passengers for half a day, with an ample allowance for waste of energy. The car with its load of accumulators weighs as much as five tons. The promoters are sanguine enough to believe that at no distant day they may be able also to introduce electric cabs and omnibuses guided like velocipedes; they calculate upon being able to work tramways with electricity at one-half the cost of horse-power. The experiment was carried out by Mr. Radcliffe Ward, on behalf of the Faure Accumulator Company.

TELEGRAPH AND SIGNAL SERVICE.—The *Montreal Gazette* of the 13th February gives the following under the head of "Inland Revenue Report to Dominion Parliament:"—

Since the 1st January, 1881, the Government has been in possession of 430 miles of telegraph lines and of 16 knots of submarine cables in British Columbia purchased from the Western Union Telegraph Company. This purchase has given a threefold advantage—1st, The Government has no longer to pay the subsidy of 4,000 dols. to the company, nor the annual sum of 2,500 dols. for the maintenance of the line which traverses Washington Territory; nor, lastly, a sum of nearly 6,000 dols. per annum for the maintenance and repairs of the six submarine cables *viâ* St. Juan Island; 2nd, The same company pays 1,200 dols. per annum for services rendered at the Relay Station of New Westminster, and collects all the receipts at the Victoria Station, representing about 1,000 dols. per annum; 3rd, The Government and the public profit by a reduction of about 5,000 dols. on the charge for despatches. In British Columbia there are now about 676 miles of telegraph lines and 36 knots of double submarine cables. The receipts from these lines and cables, which in 1878-79 amounted to only 5,320 dols., will, in 1881-82, probably reach 18,000 dols. or 20,000 dols. The submarine cables between the Island of Anticosti and the coast of Gaspe, and the Magdalen Islands and Cape Breton, have worked very well. The Bird Rock cable has three times suffered damage and been repaired, and a very stout cable is kept in reserve for any injury which may henceforth arise. During the year a line of 214 miles on the Island of Anticosti has been completed, a line of 84 miles on the Magdalen Islands, and, further, a cable of 9 miles in length between Etang-du-Nord and House Harbour. All these works have cost 12½ per cent. less than the estimated expenditure. Hon. Mr. Fortin, who asked for the creation of this telegraphic system, suggests that it should be extended on the north shore as far as Forteau Bay, in the Straits of Belle Isle, or rather as far as Pointe Amour, situate on the east side of the bay, and upon which is a lighthouse and alarm whistle. This recommendation is suggested by the fact that steamships and sailing vessels which frequent the River St. Lawrence all pass through the Straits of Belle Isle. Forteau Bay, which is always accessible, will also be included in the telegraphic system of Canada and the United States, which will be an inestimable benefit for the fishing boats which frequent the desolate north shore. Moreover, since steam vessels make the passage from Moville, in Ireland, to Forteau Bay in five days, this would consequently be the shortest way to transmit to Canada, by steamship, the news from Europe, which would give an incontestable superiority to the Canadian lines, and would be of enormous advantage to our fishing stations. Hon. Mr. Fortin also recommended that the telegraphic system be extended to the shores of our great lakes by means of telegraph and signal stations. Upon the north shore of the River St. Lawrence, Baie St. Paul has been connected with Chicoutimi by a telegraph line 92 miles long, and Murray Bay with Mille Vaches by a line of 84 miles. The telegraph lines in operation on the coasts of Nova Scotia now make up a length of 339 miles. The total amount expended by the Department of Public Works in the year ending June 30th, 1881, was 1,784,969 dols., of which 202,000 dols. were upon Quebec Harbour improvements, 175,000 dols. upon the Levis graving dock, 175,343 dols. upon the land and cable telegraph lines in the Lower St. Lawrence, and 84,971 dols. upon the Ottawa public buildings.

The telegraph work above referred to has been carried out under the superintendence of Mr. F. A. Gisborne, the Engineer-in-Chief of Telegraph and Signal Service of the Dominion of Canada.

WESTERN BRAZILIAN TELEGRAPH COMPANY.—The *Jornal do Commercio*, of Saturday, the 11th ultimo, says: "Western and Brazilian Telegraph Company.—We have been informed that this company, fully represented by Mr. Robert Macfie Cunningham, proposes to cede its systems of telegraph communication, with all the material of the service, to the Imperial Government."

THE JAY GOULD CABLES.—It is rumoured that the ss. *Faraday* has been successful in establishing communication between White Sand Bay, Land's End, and Canso, Nova

Scotia, through the No. 2 Jay Gould cable. Should this rumour prove correct, Messrs. Siemens Bros. are to be congratulated in carrying to a successful issue the laying of this line. Considering the season of the year, this success should be re-assuring to all proprietors of submarine cable property, as it shows that pluck and ability are sure in the long run to reap the success they deserve. Reports have, indeed, been freely flying this week respecting the Gould cables. It has been said that the wire sheathing had proved insufficient for repairing purposes, and that on lifting the cable, in which a fault was known to exist, the cable constantly broke away. These rumours were probably floated for stock exchange purposes only, for we have it on the best authority that the first cable laid (the only one complete) is in thoroughly good working condition, and that the *Faraday* is now about to lay the shallow water part, and shore end, of the second cable on the other side of the Atlantic.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—We understand that the Telegraph Construction and Maintenance Company are offering their ss. *Calabria* for sale. As the Company has not had a vast amount of cable work to do during the past year, this is apparently a wise step on the part of the directors, and all the more so as the *Calabria* was built, we believe, many years ago.

THE GERMAN UNION CABLE.—We have no doubt that the public generally, and the shareholders of the German Union Telegraph Company in particular, would be glad to receive public notice, whether the *Stormcock*, chartered by the Telegraph Construction and Maintenance Company has been successful in restoring communication by the German Union cable. It is hardly necessary to remind our readers that this cable was interrupted in the middle of October last, and with every justice to the Telegraph Construction and Maintenance Company, we must say that they have been hard at work ever since; first with the *Kangaroo*, and afterwards with the *Stormcock*. It will be also interesting to the shareholders to know under what conditions the work was undertaken, and whether any contract was signed of any sort, before the *Kangaroo* started work.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY.—The India-rubber, Gutta-percha, and Telegraph Works Company notify us that their ss. *Silvertown* passed Portland on her way to Panama, on the 4th inst., with the remaining portion of the Central and South American Telegraph Company's cables.

That company also informs us that they have been successful in obtaining a further order for submarine cables, from Mr. J. A. Scrymser, the President of the Mexican Telegraph Company of New York. The object of this order is to extend the cables of the Mexican Company to Galveston.

Prior to the sailing of the ss. *Silvertown*, the chairman and directors of the India-rubber, Gutta-percha, and Telegraph Works Company entertained a select party on board at luncheon. Mr. Henderson, the chairman, was, through indisposition, unable to be present, and Mr. S. W. Silver, one of the founders of the Silvertown Company, occupied the chair, and was ably seconded by Mr. N. Bannatyne, his colleague on the board. Amongst the guests who were present were Mr. G. H. B. Patey, Mr. E. Graves, Mr. W. H. Preece, Sir Charles T. Bright, Sir Samuel Canning, Sir Wm. Wallace, Capt. J. E. Hunter, R.N., Major A. Wood, Mr. John Glover, Mr. Robinson Kendall, Mr. Septimus Glover, and Mr. F. H. Webb. The French Government was represented by Mr. Rambaud, Engineer in the Government Telegraph service. All the guests appeared pleased with their visit to the largest cable ship afloat.

THE DOMESTIC ELECTRIC LIGHTING COMPANY.—On Wednesday last an exhibition of the above company's system of electric lighting in its domestic aspect was given at the Crystal Palace to members of the Press. The machines and lamps, with their supplementary apparatus, are those of Mr. Edison, therefore it is unnecessary to say anything here concerning the methods of producing and utilising the electric currents. In the Victoria Cross Gallery were fitted up, in a style suitable for modern mansions, an entrance, morning room, smoking room, dining room, drawing room, and boudoir, &c., the arrangements, decoration, and furnishing of these various rooms having been performed by Messrs. Watt, Liberty and Co., Bertram and Son, Phillips and Pearce, H. and J. Cooper, Verity and Sons, and the Royal School of Art Needlework, South Kensington. It would be invidious to single out any one of the above firms where every part of the exhibition was so well done. In respect to the lighting, the first-mentioned room contained 16 lamps of the 16-candle type, the smoking room 15, the dining room 28 lights, partly of the 16 and partly of the 8-candle types. In the drawing room and boudoir there were about 32 or 34 lights of the 16-candle type. The general effect was exceedingly good, and no doubt answered every purpose intended by the exhibitors.

THE FAURE ACCUMULATOR COMPANY.—Our readers are doubtless aware that in our last issue we made several allusions to certain parts of the prospectus issued by the above company, particularly in that portion relating to the action which Sir William Thomson had taken since the Faure accumulator came before the public. Sir William wrote us a letter on Saturday last (see page 186), which corrected certain errors into which, he said, we had fallen concerning his share in the transaction. This letter appeared in most of the leading daily papers last Tuesday morning, five days before it could possibly obtain publicity through the medium of our columns. The explanation of this peculiar method of procedure is shown in the following note, sent to us by Sir William, and dated 7th March.

DEAR SIR,—Thanks for your note acknowledging my letter of Saturday. My friend Mr. Seymour Grenfell, one of the directors of the Faure Company, to whom I sent on Saturday a press copy of my letter to you, telegraphed to me yesterday, asking permission to communicate a copy of the letter to some of the daily journals, because he thought that the interests of the Faure Company might suffer through delay in the correction of the misapprehension until the publication of your next number. I gave him permission, because I thought in the circumstances it was fair to do so. I write to you to let you know this has been done, as I would not like you to think that I had acted uncourteously to you. Trusting you will agree that I have done right in this matter,

I remain,

Yours truly,

WILLIAM THOMSON,

The University, Glasgow, *March 7th*. per J. RENNIE.

At first we decided not to take any notice of Sir William's strange conduct, and, without comment, to accept his reasons for acting in such a manner. In consequence, however, of having received from a correspondent a copy of the *North British Daily Mail* of the 7th, containing a similar advertisement to those of the London papers, we cannot maintain the silence which we had intended, for it seems more than probable to us (indeed, we see no other way in which it could happen) that Sir William himself must have caused this advertisement to have been forwarded to this Glasgow paper on the 6th, the same day on which he says he gave permission to his friend, Mr. Seymour Grenfell, to publish it in the metropolitan papers. We will pass by the question of courtesy on Sir William Thomson's part; but seeing that Tuesday, the day on which these advertisements were published, was of the same date as that on which the application for shares to country subscribers closed (the list for London already having been closed on the day previous), we can but feel that our remarks, whether correct or incorrect, have been simply used as a means to further advocate the merits of the Faure accumulator, and which must either have been intended to influence the subscriptions of those residing in the country, or to set at ease the minds of those who had already taken shares. We are not pecuniarily interested in the success of one accumulator or another, but we do desire heartily the genuine advance of electrical science in whatever direction. Therefore we cannot discountenance too strongly anything which takes the shape of undue pressure, especially when coupled with a name which should command the respect and confidence of the public at large in any matters connected with electrical inventions. If the Faure accumulator is all that is said of it, and has all the advantages which are claimed for it, the course pursued, we think, should not have been necessary. "Good wine needs no bush."

ERRATUM.—Page 168. For 500 "webers" read 500 "ohms."

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

THE TELEPHONE CASE.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—The case of the United Telephone Company *v.* Maclean, recently decided by Lord M'Laren, appears to me to require some further notice, in the interests of the public as opposed to those of an attempted great monopoly. The law of the question is not in dispute, and I desire to confine my remarks to the facts, as to few of which there is any dispute, and as to the electrical action of the telephone and microphone. I have made many hundreds, I might almost say thousands, of experiments with different forms of microphones and telephones, partly with the object of ascertaining the most efficient instruments, and partly for the purpose of endeavouring to understand the manner in which those instruments act. Since Lord M'Laren gave his judgment I have made a further series of experiments, with the view of satisfying myself on the question as to whether the hard carbon microphone acts as a tension regulator in a closed circuit, or by a simple make-and-break, as was the case with Reiss's old transmitter. It is necessary here to consider what is the action of the telephone receiver. It is alleged and maintained in the most positive manner by Sir W. Thomson and Sir Frederick Bramwell that the human voice cannot be transmitted and reproduced by any electrical apparatus that works on the make-and-break plan, and can only be transmitted and reproduced by an apparatus that acts by what Bell calls an undulatory current, and which I understand he claims to have invented and to have protected by patents. I may here remark, and I do so solely on account of the great weight that Lord M'Laren has given to their opinions, that Sir F. Bramwell said he became an "allottee of shares in the original telephone company," that he held three shares in the new company, and had increased his holding; whilst Sir William Thomson used the term *we* in speaking of himself and the complaining company; so that these two gentlemen can hardly be looked upon as witnesses having no interest in the consequences that might flow from the opinions that they expressed. The phrase used by Sir Frederick Bramwell, "became an allottee of shares," is usually understood to mean that the shares were presented, and I do not see anything in Sir F. Bramwell's evidence that indicates that a different interpretation is to be placed on his words. Now, as to the action of the telephone receiver, there is a great deal in Bell's specification about undulatory, intermittent, and other currents of electricity, that looks very learned at first sight, and would lead one to imagine that Bell's alleged discovery of the telephone was the result of a careful study of those various currents. But I feel pretty confident that such is not the case, and that Bell's theory of the action of the telephone that bears his name was formed after, and not before, he had succeeded in reproducing some of the sounds of the human voice. At all events it is clear that the idea of an undulatory current could not have led to the discovery of the permanent magnet telephone, that is, the arrangement in which similar instruments are used both as transmitters and receivers; as in this arrangement, that which Bell describes as an undulatory current is not generated by the transmitter, and consequently cannot be used to affect the receiver.

If Faraday is right, and with all due deference and proper respect, I prefer Faraday to any of the electrical professors of the present day, even to "the most eminent electrician in the United Kingdom," an induced magnetic current generated by apparatus similar to the Bell permanent magnet telephone is instantaneous only: under one set of circumstances that induced current flows in one direction, and under another set of circumstances in the opposite direction, but in whichever direction it flows it is instantaneous and instantaneous only. The undulatory current, claimed to have been invented by Bell, is a current constantly flowing in the same direction, but the quantity and intensity of which is made to vary; and I repeat that if Faraday is right, and he is supported by all the electrical authorities except the few who take particular views of the Bell telephone, such undulatory current is not generated in or by a Bell telephone when such telephone is acting as a transmitter; and therefore the reproduction of sound in the Bell telephone, a Bell telephone being used as a transmitter, is not, and can not be, caused by what Bell calls an undulatory current.

It will be noticed that even on the admissions of the witnesses and counsel for the complainers, if the theory of the undulatory current in the telephone falls to the ground, Bell's alleged great invention falls also, except on one point, which I will allude to presently, or on another occasion.

Let us apply another test to the action of the telephone. In "Deschanel's Natural Philosophy" I find that the deepest note used regularly in music has 32 complete vibrations per second, and that the highest note used seldom exceeds 3480 vibrations per second. It is conceded that musical notes have many years ago been transmitted and reproduced by apparatus working on the make-and-break system, but I could not ascertain that the highest notes could be so transmitted and reproduced. I therefore tried the following experiment. I can easily tread my lathe five revolutions in two seconds. The mandril makes eight revolutions per one of the driving wheel, therefore 20 revolutions per second; the division plate has 300 holes in one circle, so that at full speed 6000 holes would pass a light pointed spring per second. I connected one pole of the battery with the lathe, the other through a Bell telephone to a spring point, revolved the lathe at speed, placed the spring point against the 300 division on the plate, with the result that a horrid shriek is produced in the telephone, which varies in tone at different parts of the revolution of the driving wheel, showing how difficult it is to tread a lathe at an even speed, and that the tone in the telephone varies according to the number of holes passing the spring point in a given time. This is further proved by moving the spring point to one of the other circles of divisions.

It cannot be denied that in this case the sound is produced in the telephone by a make-and-break current, and even supposing that nearly one half of the portions of the plate between the holes on the 300 circle do not touch the spring point, still you have a number of makes-and-breaks per second exceeding the number of the vibrations in the highest note used in music. I find, however, in Deschanel that the average compass of the human voice is about two (2) octaves, varying from 87 to 775 vibrations per second; so that by make-and-break you can transmit a number of currents of electricity per second both fewer and greater than the number of vibrations to be found in the full compass of the human voice. This being so, why cannot make-and-break transmit and reproduce the human voice in the telephone. I think it can be shown that it will do so, and that it is by make-and-break that hard carbon microphones work, and that they cannot and will not work in any other manner. Indeed it has been stated that Dolbear uses with great success Reiss's old transmitter with his new static telephone receiver, and Reiss's transmitter, as it was admitted at the recent trial, worked by make-and-break. I may here mention that according to "Prescott on the Telephone" the permanent magnet telephone was designed by Dolbear, and I have not seen that this claim of Dolbear's has been publicly denied by Bell. Bell may be a great inventor, but he has no right to claim the monopoly of that which was public property, and was well known to every one long before he entered the field. My view is that Bell noticed an effect, and that he at once thought that he had discovered a cause.

Should this communication be of sufficient interest to find a place in your columns, I will return to the subject, and give you the particulars of other experiments with both transmitters and receivers, and the conclusions that I have deduced from them. In the mean time I inclose a description of my cup-and-ball microphone and electro-magnet receiver, which clearly work by make-and-break, are not protected by any patent, can be made and used by any

one, and are in my judgment at least equal to any of the patented instruments, whilst the receiver is not very sensitive to small induced currents.

I am, Sir, your obedient servant,

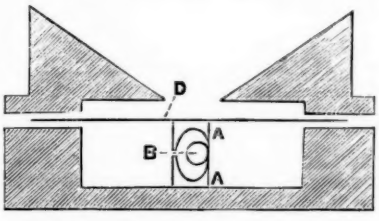
H. B. T. STRANGWAYS.

5, Pump Court, Temple, E.C.
February 21*st*, 1882.

CUP-AND-BALL MICROPHONE.

To construct the cup-and-ball microphone, take the case of an ordinary Bell telephone, remove the magnet and coil, cut off the long end or handle which contained the magnet, and plug up the hole in the case; turn the two cups out of a piece of a round carbon rod, $\frac{3}{8}$ in. in diameter, and make the ball out of a piece of round carbon rod 3-16ths of an inch diameter. Secure one of the cups to the centre of the wooden case of the telephone by a small screw, and the other cup to the centre of the diaphragm of the telephone by a lead rivet; place the carbon ball in the cup which is secured to the case, and place the diaphragm with the cup attached to it in its former position in the telephone case, having of course first carried a wire from each carbon cup to a terminal screw; see that the two cups are concentric; screw in the mouthpiece, and the microphone is complete. The microphone must be mounted in gimbals like a looking-glass, and slightly inclined backward or forward, until it speaks quite clearly, when it may be clamped. Each microphone has one position in which it speaks best, and this position must be found by actual trial. If the microphone is intended for ordinary use, the diaphragm should be made of thin deal, straight-grained and about $\frac{1}{16}$in. thick. After the carbon cup is attached, the wooden diaphragm should receive, in the side against which you speak, a coat of thin white hard varnish, put on in a dry room with a wide brush.

The following is a rough sketch of the complete microphone:—



In this sketch A A are the carbon cups, B is the carbon pea, D is the diaphragm, and the shaded parts represent the telephone case, which, as drawn, is not closely screwed up. The pea should be round, the cups conical, and the microphone is placed vertically. The open interior part of the case, that is the part which determines the area of the free vibrating portion of the diaphragm, should be $2\frac{1}{4}$ in. in diameter; the other dimensions may be varied according to fancy, but the carbon cup attached to the diaphragm should not be more than about $\frac{1}{4}$ in. in length. There is no difficulty in turning the carbon cups, the only tools required being a bradawl, which makes a capital drill for carbon; an old file to smooth down the back and face of the cup, which can, however, be done with emery-paper; the stump of any old small chisel ground to a long cutting slope, and a fret saw. It is desirable to turn a small piece of boxwood to such a shape as will fit into the cup when completed, and by pushing this lightly into the cup whilst it is running in the lathe, the interior of the cup will be smoothed, and in many cases polished. To make the ball, chuck a piece of 3-16th round carbon rod, and at the end turn a round head, like the head of a pawn in a set of chessmen; get it as nearly round as possible—a file is the best tool for this—and then cut it off; rub off any projections on emery-paper; the remainder of the process may be done in two ways. Tack a sheet of emery-paper on a board, secure another piece of emery-paper to a conveniently-shaped piece of wood with a flat face; put the carbon pea on the emery-paper tacked on the board, and, with the other piece of emery-paper-covered wood, rub the pea about in every direction between the two, and with a little care the pea will become nearly a true sphere. The other way, which I was advised to adopt by Mr. Yeates, of King Street, Covent Garden, is, take a piece of sheet-steel, about as thick as a saw blade and about 2 in. long by $\frac{3}{4}$ in. wide, soften it, chuck it by means of sealing-wax; drill a hole, about $\frac{1}{8}$ in. in diameter, through the centre—the exact centre is not required; then with a *very keen* edged tool enlarge this hole to about 5-32nds of an inch in diameter, and take care that the edges of this hole are left sharp and not rounded, then harden the plate as hard as you can make it. Now take the carbon pea which you have roughed down in the lathe, put it in the hole in the steel plate, rub it round in every direction between the finger and thumb, and after a while it will pass through the hole and be almost a true sphere. I have made the carbon balls by both these processes, and though the latter is by far the most accurate, the former has answered very well. One plate will make a great many balls. In all microphones the points actually in contact, or which regulate the current, oxidise, and, when this is complete, the current will not pass. In this cup-and-ball microphone, fresh surfaces are constantly coming in contact, and a shake will always insure this. If the microphone is properly constructed the ball should rattle loudly when the microphone is shaken. In screwing up the microphone, the diaphragm should not be pinched too tightly. I find that the best way is to screw it up a little too tight, and then slack it slightly. It will be seen from the section plan that this microphone need not be round in shape, it can easily be made square, in which case the dimensions should not be less than 4 in. by 3 in., and a mouthpiece may be dispensed with. I have made a microphone with four sets of cups and balls, the diaphragm being about 7 in. in diameter, and the cups arranged, three pairs equidistant in a circle 3 in. in diameter, and the fourth pair in the centre; the cups in the diaphragm being connected together, and the cups on the back or case also connected. With this arrangement a very strong battery may be used, when the articulation is a little louder, but scarcely so distinct as with one pair of cups only. If a multiple microphone is made up, the cups should not, I think, be less than $1\frac{1}{2}$ in. or more than 2 in. apart.

The receiver is made as follows:—Take a round piece of mahogany, or other dry wood, 2 in. in diameter, and $\frac{1}{2}$ in. thick; in the centre make a circular hole the size of a sixpence to take the electro-magnet; on one face mark a circle the size of a bronze penny; just outside this circle, and touching it, make three holes equidistant from one another, and the size of No. 9 B.W.G. iron wire; in each hole put a piece of this iron wire, long enough to project a little from the wood on each side; the electro-magnet is made of a piece of the same No. 9 B.W.G. iron wire, slightly less than $\frac{3}{8}$ in. long, and the reel is the size of a sixpence, is $\frac{1}{2}$ in. long, and is wound with No. 36 silk-covered copper iron; the electro-magnet is placed in the hole in the wood, the end of the wire carried out to connect with the terminals, and the whole boiled in paraffin. Two pieces of thin wood, about 3-16ths of an inch thick and 2 in. in diameter, are also required. In one a recess is made the size of a penny and rather less than 1-16th of an inch deep; in the other a similar recess, but with a central aperture about $\frac{1}{2}$ in. in diameter, to permit the sound to escape; two discs of thin iron, five *mils* thick, or ferrotype plate, are also required. Now take the disc of wood containing the electro-magnet, the wires of which have, of course, been led to convenient terminals; file down the ends of the three iron wires on one side of the disc, until one of the thin iron discs, when laid upon these three iron wires, will *almost* touch the core of the magnet; let this plate remain on these three wires, put on the recessed disc of wood, which is without the central aperture, and secure it by three screws. The setting of the other thin iron plate requires more care, but is done in the same way; the projecting ends of the thin wires being filed down until the other thin iron plates, when placed upon them, and the whole put in circuit with an articulating microphone, speaks distinctly: the recessed disc of wood with the central aperture is then placed upon the iron plate, and secured by three screws, which must not be tightened too much, or the plate will not speak nicely. We have now an electro-magnet between two thin iron plates, which plates are in metallic connection with one another, by the three iron wires; one plate being adjusted at the best speaking distance from the core of the magnet, and the other plate as near to the core of the magnet as it can go without touching it at any time.

I think the above directions will enable any one to make both the cup-and-ball microphone and the electro-magnet receivers, and I am sure that they will be satisfied with them; but I must ask people to remember that a good receiver is of no use with a bad transmitter, or a good transmitter with a bad receiver.

I have had these instruments in use for some two years; they work admirably and give no trouble. For telephone work, I prefer the gravity Daniell battery to any other, but I intend to try the per-chloride of iron battery.

INCANDESCENT LAMPS.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—Wishing to work about half a dozen of Swan's incandescent lamps, I wrote to a firm in London, stating fully what I required, and they forwarded me a 6-horse machine (Siemens). I obtained ample driving power from a large engine, and found I could light a Jablochkoff lamp, fuse a watch spring and other resisting wires inserted in circuit, but could not get the least sign of incandescence in any of the lamps. Can you or any of your readers enlighten me as to the cause? I noticed some of the brass pieces on which the brushes rest were loose, and at times came in contact with the next one. Would this cause the failure?

INQUIRER.

[In order to obtain a current from a self-excited dynamo machine, it is necessary that the resistance of the external circuit should not be much in excess of the resistance of the machine itself, otherwise the inducing electro-magnets cannot have sufficient magnetism excited in them to induce a current in the revolving coils. "Inquirer" has probably joined up his lamps in "series," so that their total resistance is very high; but the resistance of a single lamp even would be too great to allow the machine to work. To get any effect, a number of the lamps should be joined up in "multiple arc," *i.e.*, one terminal of each lamp should be connected to a wire joined to one terminal of the dynamo, and the other terminals of the lamps should be joined to a second wire, the latter being connected to the other terminal of the dynamo. By this arrangement the current from the machine, instead of passing through each lamp in succession, splits between each. The combined resistance of, say, six lamps thus arranged, is only $\frac{1}{6}$th of the resistance of one lamp, whereas if the lamps are arranged in "series" the total resistance of the six lamps will be six times that of one

lamp. "Inquirer" may possibly find that it will be necessary to join up more than six lamps in "multiple arc" in order to obtain a sufficiently low external resistance to enable the dynamo to develop its power properly. A dynamo machine requiring 6 horse-power to drive it would keep from fifty to sixty Swan lamps in action.—ED. ELEC. REV.]

To the Editor of THE ELECTRICAL REVIEW.

DEAR SIR,—Seeing your answers to correspondents, I thought I would write to you and seek your valuable advice. I am thinking of using six Swan incandescent lamps, and could you inform me the best and most substantial quantity battery to use to same. I have tried 40 Grove cells (quart) and have not had satisfactory results, the zincs being consumed much too fast for a lasting battery. Would 40 half-gallon Bunsen cells do, with sulphuric acid more diluted? Thanking you in anticipation for your advice,

I am, dear Sir, yours faithfully,

ONE IN A FIX.

27, Clarence Street, Wolverhampton.
March 6th, 1882.

[40 Bunsen half-gallon cells should do for your six Swan lamps, but you cannot expect them to last for long. Read our article on "Unscientific Journalism" in our issue of January 21st, and the paper by Alfred Bennett on "A Cheap Form of Voltaic Battery" in the issue of February 18th.—ED. ELEC. REV.]

FAURE ACCUMULATORS.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—In your number for to-day, p. 164, you say, referring to my opinion regarding the value of the Faure accumulators: "It has been said for some time past that Sir William had privately admitted being mistaken as to their efficacy and practicability." As this is an incorrect statement, you will, I am sure, have satisfaction in publishing my unqualified denial of it. Since my return to Glasgow at the beginning of November, I have been unintermittingly engaged in experiments on the Faure accumulators, from which I anticipate results of great practical value. I have at present, in constant use for electric lighting, a battery of forty elements in series, each consisting of three cells of Faure's original pattern. This battery includes three cells, out of the original box of four brought to me from Paris last May, and the others were made by myself in Glasgow for my own experiments, by permission of the proprietors of the Faure patents, during the time I acted for them as consulting electrician. This battery serves as reserve store for the lighting of my house, which is now done in every room and passage, from attic to cellar, by Swan and Edison lamps. Thus at the present moment (10 o'clock in the forenoon), while writing in my study, I have (merely for the purpose of verification) four Swan lamps brilliantly incandescent by what remains in the battery from yesterday's charge, and two hours' reduced lighting of the house, after the engine and dynamo were stopped yesterday evening. The reserve that remains is far more than sufficient for any practical use in this bright weather, until the engine is again started for this evening's lighting. The reserve, even at this season, is very convenient for occasional lighting during the day in dark rooms or cellars, where, without the electric light, lucifer matches and gas jets have hitherto been required.

I remain, Your obedient servant,

WILLIAM THOMSON.

The University, Glasgow, *March 4th*, 1882.

THE AMERICAN ATLANTIC CABLE COMPANY.

To the Editor of THE ELECTRICAL REVIEW.

DEAR SIR,—At the meeting of the Direct United States Cable Company, reported in your issue of the 25th ult., a statement was made by the chairman to the effect that in the attempt to repair one of the cables of the American Atlantic Cable Company, which was broken in course of laying, the other cable had been cut through.

There is not the slightest foundation for this statement. The cable was broken, near the Flemish Cap, by accidental causes, and was not cut through by a grapnel or other mechanical means, as reported.

The cable was repaired, on the 1st instant, at a depth of 1,950 fathoms, and is now again in perfect condition.

I am requested by my board to ask you to kindly insert this correction in your next issue, and am,

Dear Sir,

Yours faithfully,

ALFRED SABINE,
Sec.

Siemens Bros. & Co., Limited,
12, Queen Anne's Gate, Westminster, London, S.W.
March 3rd, 1882.

RAILWAY SIGNALLING.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—Respecting your remark, after the letter of mine which you were good enough to publish, you seem to have fallen into error. I understand many railways abroad are adopting methods of signalling similar to mine, and I have seen it for myself on the "Chemin de fer du Nord," in France.

Yours truly,

DAVID SALOMONS.

Broomhill, Tunbridge Wells,
March 7th, 1882.

REISS'S APPARATUS FOR REPRODUCING MUSICAL SOUNDS.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—Referring to an article in your edition of the Review for March 5th, entitled "Reiss's Apparatus for Reproducing Musical Sounds," is it not possible that when the diaphragm is set in vibration by "articulate sounds" that a minute voltaic arc is established between the points of contact, the variation in extent (and therefore in resistance) of which causes a corresponding variation in the strength of the "current"? Hence the supply of "intensity" and "timbre" to the sounds reproduced in the receiver.

Yours truly,

C. J. COOKE,
G. N. Ry. Tel. Dept., Leeds.

March 5th, 1882.

[Your theory has been suggested before. It seems quite possible that it has truth in it.—ED. ELEC. REV.]

TECHNICAL INSTRUCTIONS FOR CABLE WORKING.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—Would you kindly at your convenience answer me the following question, Do the cable companies issue technical instructions and diagrams of apparatus to their staffs? Would it be possible for any one not in their employ to obtain a copy? I principally wish to gain information regarding duplexing cables.

Yours obediently,

B.

March 6th, 1882.

[Perhaps some of our readers can give information on this subject.—ED. ELEC. REV.]

NEW PATENTS—1882.

985. "Improvements in the construction of apparatus for lighting gas by electricity, parts of which improvements are also applicable to other electrical appliances." C. L. CLARKE and J. LEIGH. Dated March 1.

986. "Dynamo electric machines." W. H. AKESTER and T. B. BARNES. Dated March 1.

1002. "Electric rotary or revolving hair brush." H. LEBSNER. Dated March 2.

1017. "Insulating apparatus for overhead telegraph lines or other wires for carrying electric currents." J. S. LEWIS. Dated March 3.

1020. "Apparatus for transmitting and receiving sound." J. RAPIEFF. Dated March 3.

1023. "Means for indicating and regulating the current of electrical generators for supplying electric lights and other purposes." T. J. HANDFORD. (Communicated by T. A. Edison.) Dated March 3.

1024. "Construction and working of junction or switch apparatus, specially applicable for use in telegraph or telephone exchanges or stations, or for other similar or equivalent uses." W. E. IRISH. Dated March 3.

1027. "Incandescent electric lamps." F. WRIGHT and M. W. W. MACKIE. Dated March 3.

1031. "Vacuum pumps for exhausting bulbs of electric lamps or other vessels." F. WRIGHT and M. W. W. MACKIE. Dated March 3.

1034. "Galvanic chains." C. D. ABEL. (Communicated by A. L. A. Kraehmer.) Dated March 3.

1036. "Manufacture of carbons suitable for electrical purposes, and apparatus connected therewith." H. LIEPMANN and P. S. LOOKER. Dated March 3.

1044. "Telephone transmitters." R. and M. THEILER. Dated March 4.

1054. "Telephonic apparatus." N. C. CHERRILL. Dated March 4.

1079. "Improvements in the construction and manufacture of incandescent electric lamps and in the apparatus used therein." W. CROOKES. Dated March 6.

1085. "Electro-magnets and armatures therefor for electro-mechanical telegraphic and other purposes." W. P. THOMPSON. (Communicated by G. Smith.) Dated March 7.

1094. "Sockets or holders for electric lamps." E. H. JOHNSON. Dated March 7.

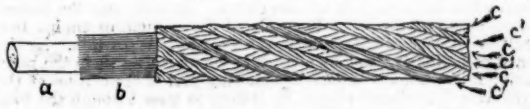
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

2712. "Transmitting secret correspondence by telegraphs, &c." DONALD NICOLL. Dated June 21. Relates to certain improvements in the apparatus for and method of transmitting secret correspondence by public mediums, and more especially by the electric telegraph. (*Provisional protection not allowed.*)

2739. "Distributing electricity." H. E. NEWTON. (A communication from abroad by M. A. Gravier, of Paris.) Dated June 22. 8d. Consists in the application of derived circuits so as to distribute the electricity from whatever source derived in determined proportions throughout a system comprising a certain number of apparatus; to preserve to each apparatus the intensity which is proper to it; to assure the independence of these apparatus the one from the other, in such a manner that when used, say, for example, for electric lighting, any number of lights may be lighted or extinguished without disturbing the working of the others; to insure that the production of electricity shall be always in proportion to the requirements of the case. The invention also consists in the use of a return wire and current, the object of which is to bring to the generator from a conveniently chosen point indications, without which it would not be possible to give a regulated production of electricity as required; a regulator of production for regulating automatically the electromotive force of the generator; a regulator of energy or of consumption; a commutator arranged so as to remove from the distribution any lamp and its entire circuit; an equaliser of light, that is to say, an apparatus which permits of the luminous intensity of the light being regulated; a distributor insuring a good division of electricity in the system, and the employment for this special use either of the secondary element of M. Planté, or more simply and economically, of a metallic mass connected to the generator by the return wire which commands the regulator of production.

2867. "Telephonic apparatus." W. ERO POTTER. Dated July 1. 6d. The main objects of the invention are to provide telephonic apparatus so arranged and combined that the normal condition of such apparatus is on call, that both hands are free when a message is being received, and that the parts are moved from call to sound by an easy and natural motion when moving into position to receive a message. In carrying the invention into practice the switch is of any usual or desired construction, either pivoted or sliding, and it is automatically held in position to open the call circuit by means of a spring or weight. A rod, wire, or equivalent agent connects the switch with a pedal or other suitable appliance for giving motion when acted upon by the foot or otherwise to the said rod or its equivalent, and with it to the switch. The pedal or like appliance is secured to the floor, or is fixed in any other convenient position.

2944. "Manufacture of electric telegraph wire ropes or cables." J. P. HOOPER. Dated July 5. 6d. Relates to the manufacture of all electric telegraph cables where wire strands are employed for the sheathing, whether such strands are composed of wire only or a combination of wire and hemp. In the figure, A is the central insulated core containing the metallic conductor or conductors; B is a covering of hemp strands wound around the core; C, C^1, are alternate strands of wire forming the outer sheathing of the cable. The wire strands, C, have the wires of which they are composed laid in one direction, whilst the wires of which the strands, C_1, are composed are laid in the opposite direction. The machinery employed in the making up of the cable may be the same as has heretofore been used for making wire rope electric cables, except that for the making of the strands C, C^1, two machines are employed, similar in construction, but with the shaft carrying the bobbins of wire which are to be made up into



a strand driven in one direction in one machine, and in the opposite direction in the other machine. In this way the wires of the strands made in one machine will be laid in one direction, whilst the wires of the strands made in the other machine will be laid in the opposite direction. In both machines the strands as they are produced are wound up on to bobbins.

2986. "Telephonic signalling and commutating apparatus." JOHN IMRAY. (A communication from abroad by Clement Ader, of Paris.) Dated July 7. 6d. This invention relates to the signals and commutators employed for telephonic exchange systems. For signalling according to this invention a solenoid coil without a core is suspended like a pendulum between the poles of permanent magnets, its middle position being determined by an adjustable counterbalance weight. The pendulum rod has on it contact studs, which when the pendulum is in the middle position are clear from fixed studs communicating by wires with the signal. On sending an electrical current from a local battery through the solenoid coil it is caused to move in the one direction or the other, according as the current is of the one or the other sign. By this deflection of the pendulum one or other of the contact studs on its rod makes contact by which a current is transmitted to the signal, causing it to move so as to indicate the desire of the subscriber for communication.

2988. "Telephonic apparatus, &c." G. LEE ANDERS. Dated July 7. 8d. Relates to improvements in telephonic apparatus, and has reference to the arrangement of the telephones themselves, and to the construction of signalling apparatus to be used with the telephones for notifying from a central station to a branch station, and also to the construction of the switch board to be used at the central station; but a part of the invention is also applicable to other electrical or magnetic apparatus.

2995. "Telephonic and telegraphic signalling apparatus." A. C. BROWN and H. A. C. SAUNDERS. Dated July 7. 6d. The object of the invention is to facilitate the intercommunication between several telephone or telegraph stations on one and the same wire. For this purpose there is employed apparatus so arranged that not only can any station call up and be placed in direct communication with any other station on the same wire without having to go through a central office, but also so that none of the other stations can interrupt or hear what is passing between the two stations occupying the wire; and when telephonic apparatus is used, so that upon cessation of communication upon the caller replacing the telephone upon the switch hook, upon which the telephone is ordinarily suspended whilst out of use, his bell will continue to ring until he clears the line by bringing all the instruments back to their normal position; and also so that all the stations in circuit can see that the line is engaged, and also which station has been called up. In carrying out this invention there is employed at each station an instrument having a dial, upon which is marked numbers or signals corresponding with the number of stations to be in circuit upon the wire. The stations are indicated by a hand or pointer, which is made to revolve either by clock work or by a step by step movement actuated by electric currents.

3032. "Regulating electric currents, &c." Sir W. THOMSON. Dated July 9. 10d. The first part of the invention consists of an automatic appliance for regulating by means of electro-magnetic force the work of an electric accumulator by increasing or diminishing the number of working cells. One species of this appliance gives a constant strength of current, another a constant electromotive force. In the former the electro-magnetic force due to the whole current flowing through a short thick coil is used; in the latter the electro-magnetic force of the branch current through a coil of long fine wire connecting the working electrodes is used. One mechanical method by which the electro-magnetic force to produce the desired result is directed is a metallic roller, caused by it to roll over contact pieces connected with the cells alternately by short thick metals and by wires or resistance coils having sufficient resistance to prevent inconveniently great currents by momentary short-circuitings of cells. The roller itself is connected by a sliding contact with the circuit in which the work is done. The second part of the invention is an improved method for keeping the strength of an electric current or the electromotive force between two conductors as nearly constant as may be, while changes are made in the work done by the current or by currents between the two conductors in cases in which a simple electro-magnetic appliance has not the requisite power to effect the regulation. It consists in applying when the current or electromotive force becomes too strong a small dynamo-electric or magneto-electric engine to do the work needed to diminish the steam power driving the main dynamo-electric machine by which the current is produced, or otherwise to diminish the speed of the machine or its electric efficiency, or to diminish the battery or the accumulator when the current is sustained by battery or accumulator. An electro-magnetic make-and-break of ordinary type or of the kind used in the third part of the invention is used in the present case to make and break the contacts for throwing on or off the small dynamo or magneto engine. When it is the strength of a current that is to be regulated the electrodes of the regulating engine are applied to points of the

main circuit, or the two sides of a contact which is broken when the current is too strong and made again when the current is not too strong. When it is e. m. f. that is to be regulated on electrodes of the regulating engine it is kept in connection with one of the main conductors. The other is put into connection with the other main conductor when the e. m. f. is too strong, and this connection is broken when the e. m. f. is not too strong. In each case the instantaneous effect of throwing the coils of the regulating engine into circuit is to check suddenly the too strong electric action. In the former case this is done by augmentation of resistance in the main circuit; in the latter it is done by shunting part of the current of the source from the external circuit by letting it pass through the coils of the regulating engine. In each case the engine gradually reduces the electric force of the source until the regulating engine is thrown out of circuit and allowed to remain out of circuit by the automatic make-and-break. When the current or the e. m. f. becomes too weak at any time there is used a corresponding automatic arrangement to direct small regulating dynamo or magneto engine to augment the exciting power by a reverse action to that described above. The same engine may serve for both the augmenting and the diminishing of the exciting power by arranging that it shall be connected so as to run in one direction when the current or e. m. f. is too great, and in the opposite direction when too small. The third part of the invention is an automatic make-and-break by which, when arrangements are made to charge an accumulator, the charging circuit is made or broken according as the electromotive force suffices or does not suffice to add to the charge in the accumulator, and is also broken when the current is stronger than desired. The fourth part of the invention consists of arrangements for applying the accumulator, or parts of it, to the source when recharging is required and freeing the accumulator or parts of it when ready for work, and apply them to the work when wanted.

3049. "Electric lamps." F. W. HADDAN. (A communication from abroad by L. G. Woolley, of the United States of America.) Dated July 12. 6d. The improvements relate to electric lamps, and consist in placing the whole of the regulating apparatus inside the dash-pot that is formed in the upper carbon-holder. Also in placing the regulating devices or apparatus in the upper carbon-holder and operating them by means of a helix or axial magnet which is applied directly to the outside of the upper end of the tube in which the carbon-holder moves. Also in the peculiar construction of the lifting device whereby when the core to which the device is attached is raised upwards or attached by the helix or axial magnet surrounding it, the elevator catches hold of the inside of the carbon-holder and raises it vertically upward without causing it to bind upon its guides.

3053. "Battery telephones, &c." LOUIS JACOBSON. Dated July 12. 6d. Consists in applying a tube to the casing or box of the transmitter into which the sounds are spoken, so that the undulations are concentrated and fall upon the diaphragm of the transmitter with much more intensity than in the ordinary apparatus. By this arrangement the loudness of the words sounding from the receiver on the receiving station is enormously increased.

3073. "Lamp casings or holders for containing and protecting electric lights," &c. DAVID GRAHAM. Dated July 14. 2d. Relates to an improved casing or lanthorn for containing and protecting electric lights, either the incandescent, partly incandescent, or arc lights. (*Provisional only.*)

3122. "Manufacture of electric bridges for lamps." ST. GEORGE LANE-FOX. Dated July 18. 2d. Relates to the manufacture of electric bridges from certain grasses or fibres, and more particularly from the grass or fibre known as French whisk. The fibres are first boiled in a strong solution of caustic soda or potash; the outer skin is then scraped or cleared off; and afterwards the fibres are boiled in water until all trace of soda or potash is removed. The fibres are then stretched on a block of carbon or other suitable material buried in plumbago, or hermetically sealed in a crucible, and raised to a white heat in the usual manner.

3146. "Effecting intercommunication in, the lighting, and the working of, the brake mechanism of railway trains by electricity." GEORGE KIFT WINTER. Dated July 19. 4d. Relates more particularly to the making of the joint between the cable and the hook at the end of each side or safety-chain more secure mechanically, and to the rendering of the contact between hook and hook of the connected chains more perfect electrically. (*Provisional only.*)

3169. "Electric machines." A. M. CLARK. (A communication from abroad by William Laing, of Paris.) Dated July 20. 4d. Has for its object to render independent of the machine the means which rectify or make the currents uniform in direction, whereby certain advantages in working accrue. This is effected by making the commutator work in water or other non-conducting fluid.

3177. "Insulated coatings and covers or cases for telegraphic wires and cables, &c." T. J. MAYALL. Dated July 21. 4d. Relates to the insulation of the wires, and to external covers or cases for protecting the same, either under or above the surface of the ground or in water, and it consists in inclosing a gang of wires within a strap, belt, or rope of rubber, gutta-percha, or other similar plastic insulating substance.—(*Provisional only.*)

3224. "Galvanic batteries, &c." J. HIGGIN and A. J. HIGGIN. Dated July 23. 2d. Has for its principal object to lessen the cost of the production of galvanic currents by means of batteries, by the employment of elements and materials which will furnish useful and valuable chemical products. (*Provisional only.*)

3305. "Apparatus for displaying and regulating electric light." Sir CHARLES TILSTON BRIGHT. Dated July 28. 2d. Relates to an electric lamp with relay regulating mechanism. (*Provisional only.*)

DISCLAIMERS.

1878. 2003. "Apparatus for the generation and application of electricity for lighting, plating, &c." Anglo-American Brush Electric Light Corporation's disclaimer and memorandum of alteration. (Haddan's patent.) (A communication from abroad by Charles Brush, of Cleveland, Ohio, United States of America.) Filed January 11, 1882.

1878. 3988. "Electric lighting, &c." Anglo-American Brush Electric Light Corporation's disclaimer and memorandum of alteration. (Lane-Fox's patent.) Filed January 26, 1882.

1878. 4043. "Applying electricity for lighting and heating." Anglo-American Brush Electric Light Corporation's disclaimer and memorandum of alteration. (Lane-Fox's patent.) Filed January 10, 1882.

1880. 781. "Sounding apparatus." Sir Wm. Thomson's disclaimer and memorandum of alteration. Filed January 10, 1882.

1881. 129. "Galvanic polarisation batteries or magazines of electricity." Johnson's disclaimer and memorandum of alteration. (A communication from abroad by Camille Faure, of Paris.) (Johnson's patent.) Filed January 10, 1882.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. March 8.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	9 - 9¼	9⅜
		Do. Do.	10	22 - 23	22½ ¼
150,000	1	Electric Light and Power Generator Co.	1	⅝ - ¾	11/16 ⅝
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	51 - 52	51.50½.11. 50½.1.50½
2,441,800*l.*	Stk.	Do. Preferred } Def'd. receiving no div. until	100	81 - 82	81.80½.1.½.
2,441,800*l.*	Stk.	Do. Deferred } 6 p. c. has been paid to Pref.	100	22 - 23	804.½.½.1.80½ 22½.11.21.2.
130,000	10	Brazilian Submarine, Limited	10	11 -11¼	11¼.⅛.⅜.1/16.⅛. ¼
16,000	10	Cuba, Limited	10	8½ - 9	
6,000	10	Do. 10 per cent. Preference	10	15½ - 16½	
13,000	10	Direct Spanish, Limited	9	5½ - 6	
6,000	10	Do. 10 per cent. Preference	10	15½ 15¾	
65,000	20	Direct United States Cable, Limited, 1877	20	11 -11¼	10¼.⅛.⅜.⅛.⅜. 11
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10 - 10¼	10¼.10
70,000	10	Do. 6 per cent. Preference	10	12½ - 12⅝	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	100 -103	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	102 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11 - 11¼	11⅛
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	103	105 -109	108
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	101 -104	103½.3
140,000	100	Do. do. registered, repayable 1900	100	101 -104	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	102⅝
254,300*l.*	100	Eastern and South African Limited 5 per cent. Mort. Deb. Registered redeemable 1 Jan. 1900	100	100 -103	101⅛
345 700*l.*	100	Do. do. do. To Bearer	100	100 -103	
22,050	10	German Union Telegraph and Trust, Limited	10	9½ - 9⅝	
163,390	10	Globe Telegraph and Trust, Limited	10	6½ - 6⅝	6⅝.½.⅝
163,209	10	Do. 6 per cent. Preference	10	12½ - 12⅝	
125,000	10	Great Northern	10	12 - 12½	
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	23 - 24	
100,000	100	Do. 6 per cent. Debentures, 1886	100	104½-108	
17,000	25	Indo-European, Limited	25	28 - 29	
38,148	10	London Platino-Brazilian, Limited	10	4⅜ - 5½	
12,060	10	Mediterranean Extension, Limited	10	1½ - 2⅛	xd.
8,200	10	Do. 8 per cent. Preference	10	8½ - 9½	
9,000	8	Reuter's, Limited	8	12⅜ - 13½	
280,000	Stk.	Submarine	100	260 -270	267.8 xd.
58,225	1	Do. Scrip	1	2½ - 2¾	xd.
4,200	Cert.	Submarine Cables Trust	100	97 -100	
37,350	12	Telegraph Construction and Maintenance	12	28 - 29	xd.
150,000	100	Do. 6 per cent. Bonds, 1884	100	101 -105	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛ - 1⅜	1⅛
30,000	10	West Coast of America, Limited	10	4⅜ - 5¼	4⅛
150,000	100	Do. 8 per cent. Debentures			
69,910	20	Western and Brazilian, Limited	20	8¼ - 8⅝	8⅛
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	105 -110	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	98 -101	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	101 -104	
88,321	10	West India and Panama, Limited	10	1⅛ - 1⅜	1⅛
34,563	10	Do. 6 per cent. 1st Preference	10	7⅛ - 8	7⅛
4,669	10	Do. 6 do. 2nd do.	10	6 - 6½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1⅛ - 1¼	1⅛.⅛.1/16
200,000	1	Oriental Telephone Co.	½	⅜ - ½	
100,000	5	United Telephone Co.		13⅛ - 13⅜	13⅛

TRAFFIC RECEIPTS.

Direct Spanish Telegraph Company, Limited. February, £2.109, against £1.876 in corresponding period of 1881.

Eastern Telegraph Company. February, £44,646, against £46,463 in corresponding period of last year.

Eastern Extension Company. February, £27,473, against £28,021 in corresponding period of 1881.

Great Northern Telegraph Company. February, £17,000, in January and February, £33,960, against £34,403 in corresponding period of 1881, and £31,488 in 1880.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending February 24th, 1882, were £2,519, and for the week ending March 3rd were £2,785, both after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West Coast of America Telegraph Company. Gross earnings for the half month ending February 28th, 1882, £1,600, against £800 in the corresponding period of last year, making the gross earnings for the whole month of February, 1882, £3,475, against £1,700 in the corresponding period of last year, showing an increase of £1,775.

The West India and Panama Telegraph Company, Limited. The estimated traffic receipts for the half month ended the 15th February are £2,908, as compared with £2,402 in the corresponding period of 1881, and for the half month ended 28th February, £2,551, as compared with £2,018 in 1881. The November receipts, estimated at £4,368, realised £4,384.